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Ambient Monitoring for PCB After Remedial Cleanup of Two Landfills in the Bloomington, Indiana Area

Battelle Columbus Labs.

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Environmental Monitoring Systems Lab.
Research Triangle Park, NC

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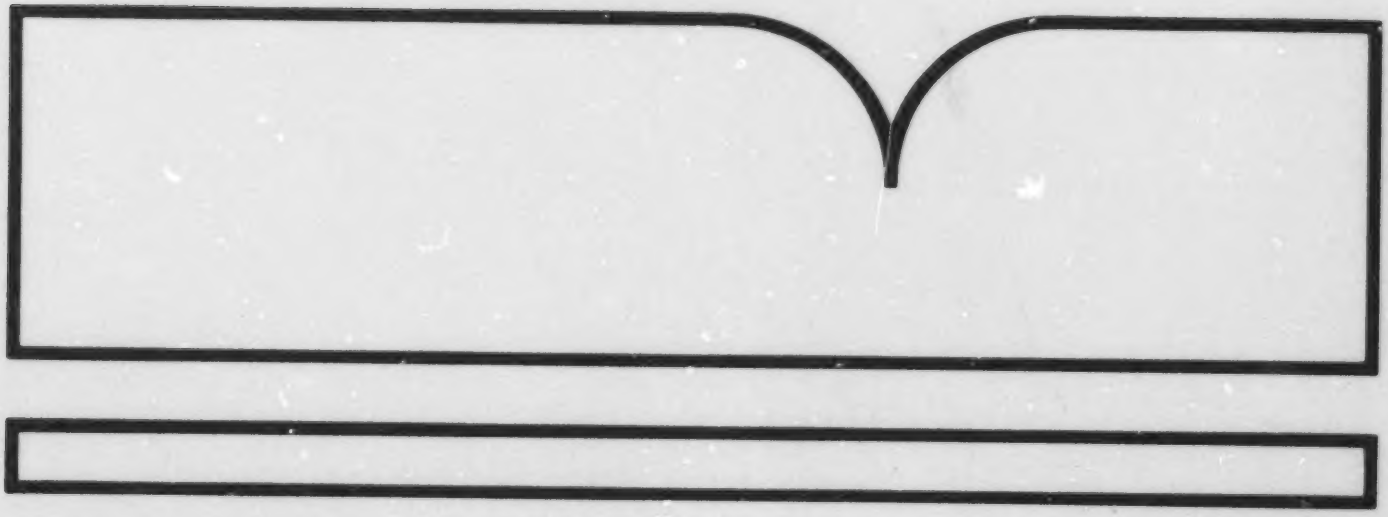

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AMBIENT MONITORING FOR PCB AFTER REMEDIAL CLEANUP OF TWO LANDFILLS IN THE BLOOMINGTON, INDIANA AREA

by

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Contract No. 68-02-3745

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16. ABSTRACT

A monitoring program was conducted to determine PCB levels in ambient air on and in the vicinity of two landfills at which interim remedial cleanup measures have been performed. The landfill sites are in the Bloomington, Indiana area. The sampling locations and methods used were the same as employed in a pre-cleanup monitoring program conducted during June and July, 1983.

Monitoring data obtained at former hot spots (on the sites where exposed capacitors were visible) showed a marked reduction from the pre-cleanup monitoring levels. However, PCB concentrations measured at downwind locations at the site boundaries during the pre- and post-cleanup monitoring were approximately the same.

Collocated monitoring conducted during the study showed that both the low- and high-volume sampling methods yielded reliable, reproducible measurements of airborne PCB levels.

This report was submitted in fulfillment of Contract No. 68-02-3745, Work Assignment No. 18 by Battelle Columbus Laboratories under sponsorship of the U.S. Environmental Protection Agency. This report covers the period from May 1984 to March 1985 and the field work was completed as of October 1984.

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FOREWORD

Measurement and monitoring research efforts are designed to anticipate potential environmental problems, to support regulatory actions by developing an in-depth understanding of the nature and processes that impact health and the ecology, to provide innovative means of monitoring compliance with regulations, and to evaluate the effectiveness of health and environmental protection efforts through the monitoring of long-term trends. In support of this objective, the Environmental Monitoring Systems Laboratory (EMSL), Research Triangle Park, North Carolina, has the responsibility for: assessment of environmental monitoring technology and systems; implementation of agency-wide quality assurance programs for air pollution measurement systems; and supplying technical support to other groups in the Agency including the Office of Air, Noise and Radiation, the Office of Toxic Substances and the Office of Enforcement.

In 1983, EMSL/RTP in conjunction with EPA Region 5 conducted a monitoring study at three landfills in the Bloomington, Indiana area to access the release of PCBs into the air and to establish a baseline prior to any remedial activities. Since that study was completed, interim remedial cleanup of two of the three landfills has been accomplished. In July 1984, a follow up study was conducted by EMSL/RTP to provide EPA Region 5 with data on airborne PCB levels following the interim cleanup of the two landfills. This document details the monitoring activities and the results obtained from the sampling at the two landfills.

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ABSTRACT

A monitoring program was conducted to determine PCB levels in ambient air on and in the vicinity of two landfills at which interim remedial cleanup measures have been performed. The landfill sites are in the Bloomington, Indiana area. The sampling locations and methods used were the same as employed in a pre-cleanup monitoring program conducted during June and July, 1983.

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CONTENTS

Disclaimer ii
Abstract iv
Figures vi
Tables vii
Abbreviations viii
Acknowledgment ix

1. Introduction 1
2. Conclusions 2
3. Recommendations 3
4. Experimental Procedures 4
   - Site/sampling location descriptions 4
   - Equipment 7
   - PCB monitoring procedures 11
   - Sample handling 13
   - PCB analysis procedure 13
   - Meteorological measurements 13
5. Results and Discussion 15
6. Quality Assurance Data Summary 23
   - Flow calibrations 23
   - Flow audit 24
   - Field blanks 24
   - Standards analysis 24
   - Collocated monitoring data 24

References 28

Appendices

A. Operating procedures for Du Pont low volume and EPA high volume samplers 30
B. PCB analysis procedure 35
C. Field sampling data 39
D. Flow calibration data 52
E. EPA flow audit report 64
F. Meteorological data 72

FIGURES

Number		Page
1	Location of landfill sites	5
2	Monitoring locations at Neal's Landfill	6
3	Monitoring locations at Neal's Dump	8
4	Low volume PCB sampler	9
5	EPA high volume ambient air sampler	10
A-1	Du Pont low volume PCB sampling data form	31
A-2	High volume PCB sampling data form	33

TABLES

Number		Page
1	Sampling program summary.....	12
2	Results of PCB monitoring at Neal's Landfill	16
3	Results of PCB monitoring at Neal's Dump	21
4	Comparison of pre- and post-cleanup monitoring data.....	22
5	Spiked cartridge analysis results.....	25
6	Collocated low volume sampler data	26
7	Collocated high volume sampler data.....	27

LIST OF ABBREVIATIONS

km -- kilometer

m -- meter

cm -- centimeter

mm -- millimeter

L/min -- liters per minute

scm/min -- standard cubic meters per minute (25°C, 760 mm Hg)

µg -- microgram (10^{-6} grams)

m/s -- meters per second

C -- degrees Centigrade

ppb -- parts per billion by volume

mL -- milliliter

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SECTION 1

INTRODUCTION

Three landfill sites in the Bloomington, Indiana, area have been used for disposal of capacitors containing polychlorinated biphenyls (PCBs). They are identified as: Neal's Landfill, Neal's Dump and Lemon Lane Landfill. Visual surveys of these sites have shown several areas where capacitors are visible at or above ground level. In most of the areas leakage of the capacitors is suspected, due to apparent wetting of the soil and damage to the surrounding vegetation; as a consequence PCBs may be emitted, thus creating an air pollution problem.

During June and July 1983, a field program was conducted to monitor PCB levels in the ambient air at selected locations on and surrounding the three landfill areas[1]. Airborne PCB measurements on the sites were performed at localized areas (hot spots) where leaking capacitors were evident. Measurements were made at locations in the vicinity of the sites to determine upwind background levels and downwind emission levels.

During the Spring of 1984, interim remedial cleanup measures were conducted at Neal's Landfill and Neal's Dump to reduce PCB emissions from the sites. Following the cleanup operations, monitoring was performed to determine the reduction of airborne PCB levels on, and in, the vicinity of the two landfill sites. The monitoring locations and procedures employed were the same as those used in the previous study. Battery-operated, personal-type pump systems were used to sample during 8-hour daytime periods at a fixed height above hot spots. High volume systems were employed to sample for 24-hour periods at hot spots, upwind background location and downwind site perimeter locations. Vertical concentration profiles at hot spot areas, during 8-hour daytime periods, were determined with an array of five battery-operated sampling systems, positioned at different elevations above ground level. Polyurethane foam (PUF) cartridges were employed in all the sampling systems to collect PCBs from the ambient air. The quantity of PCBs collected in the PUF cartridges during sampling was determined by extractic and analysis of the extract by electron-capture gas chromatography using EPA Method 608. Meteorological conditions (wind speed and direction, temperature and relative humidity) were monitored, during sampling at the sites, to assist in interpretation of the PCB measurements.

This study was conducted to provide EPA Region V with data on airborne PCB levels following interim remedial cleanup of the two landfill sites.

SECTION 2

CONCLUSIONS

The results of the monitoring program show that the interim remedial cleanup reduced airborne PCB at former hot spots on the landfill. Airborne PCB levels at the downwind site boundaries remain approximately the same as observed during the pre-cleanup monitoring.

Modification of the high volume samplers by replacement of the conventional motor with a by-pass type, significantly improved the reliability and durability of this unit.

SECTION 3

RECOMMENDATIONS

The methodology used in this program has been refined; based on experience gained in several previous field studies. It has been demonstrated that the equipment and procedures yield reliable data; they are therefore recommended for similar future studies.

SECTION 4

EXPERIMENTAL PROCEDURES

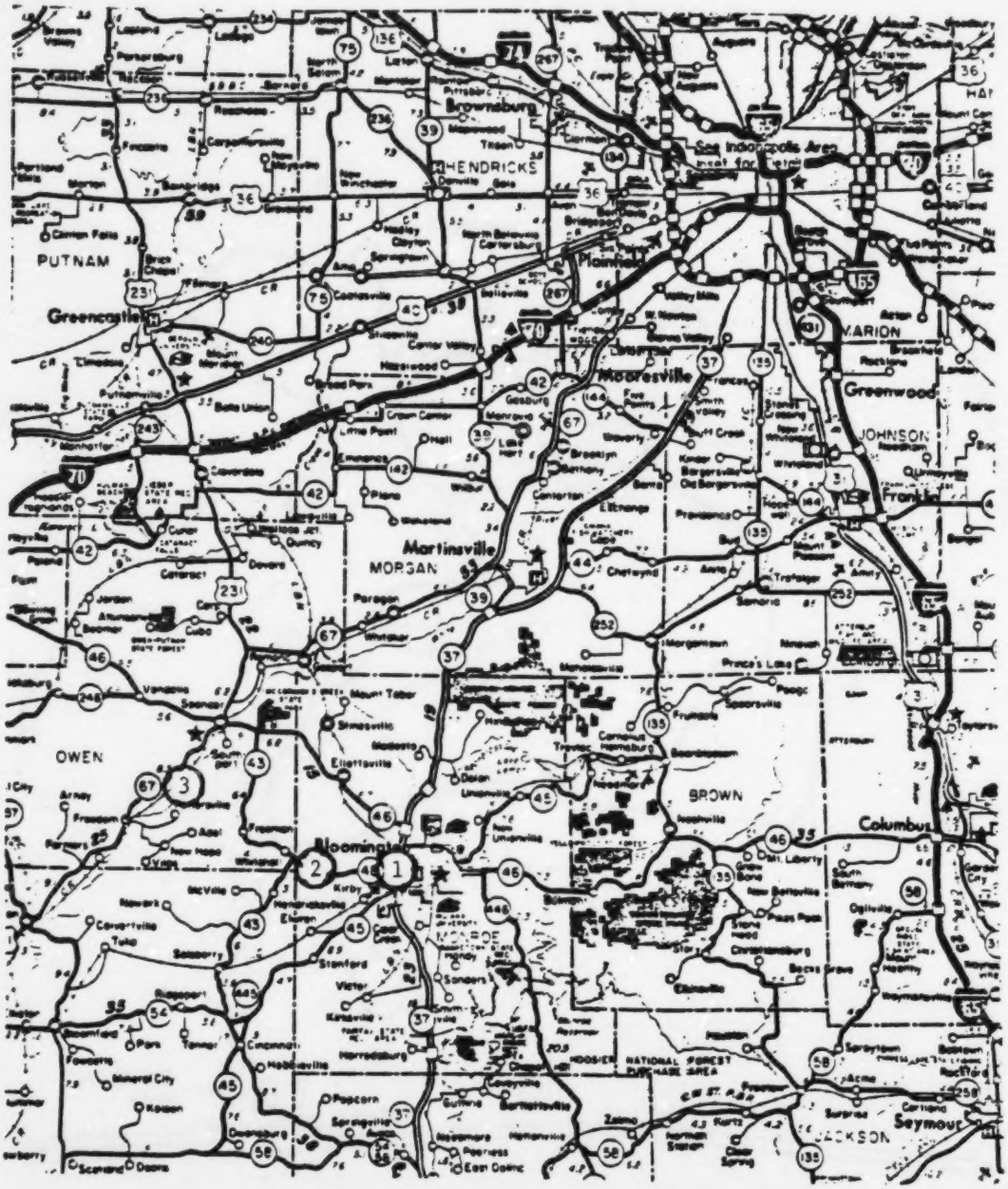
SITE/SAMPLING LOCATION DESCRIPTIONS

PCB monitoring was performed at two landfills located in a westerly direction within approximately a 5-mile radius of the city of Bloomington, IN. The respective locations of the landfills are shown on the map segment presented in Figure 1. Brief descriptions of the landfill sites and sampling locations at each site, follow.

Neal's Landfill

Neal's Landfill is located in Monroe County, directly north of Route 48, approximately 4.5 miles west of Bloomington, IN. It is located on privately-owned property. In general, the landfill proper is heavily overgrown with weeds and brush. Several dirt lanes permit use of vehicles for transit within the landfill area. The west, north and east extremities of the site are bordered by wooded areas. The general area is rather remote and very lightly populated; the nearest residences being located south of the landfill along Route 48. The closest residence is approximately 180 m (600 ft) from the landfill proper and is located near the gate to the landfill area. Preliminary visual surveys have identified approximately eight different areas on the landfill where PCB-containing capacitors are visible at or above ground level.

PCB monitoring at Neal's Landfill was performed at 7 of the 10 previous sampling locations shown in Figure 2. Three locations, designated A, C and E, were localized areas (hot spots) on the landfill proper where, prior to the remedial cleanup, leaking capacitors were visible at or above ground level. At Locations A and C, approximately 10-12 capacitors were visible. At each location, the capacitors were strewn over an area of approximately 10 m^2. Location E was a smaller area (1-2 m^2) where approximately three capacitors were exposed. Locations 2 through 4 were along the northern perimeter of the site, nominally downwind from the fill area. Distances from the edge of the fill area to these sampling locations ranged from approximately 12 m (Location 2) to 64 m (Location 4). Selection of the downwind monitoring locations was constrained by heavily wooded areas along the northern boundary of the site. The upwind monitoring point (U) was located near the gate at the entrance to the landfill site. Hot spot Locations B and D, and downwind Location 1, were sampling points used in the pre-cleanup monitoring program.

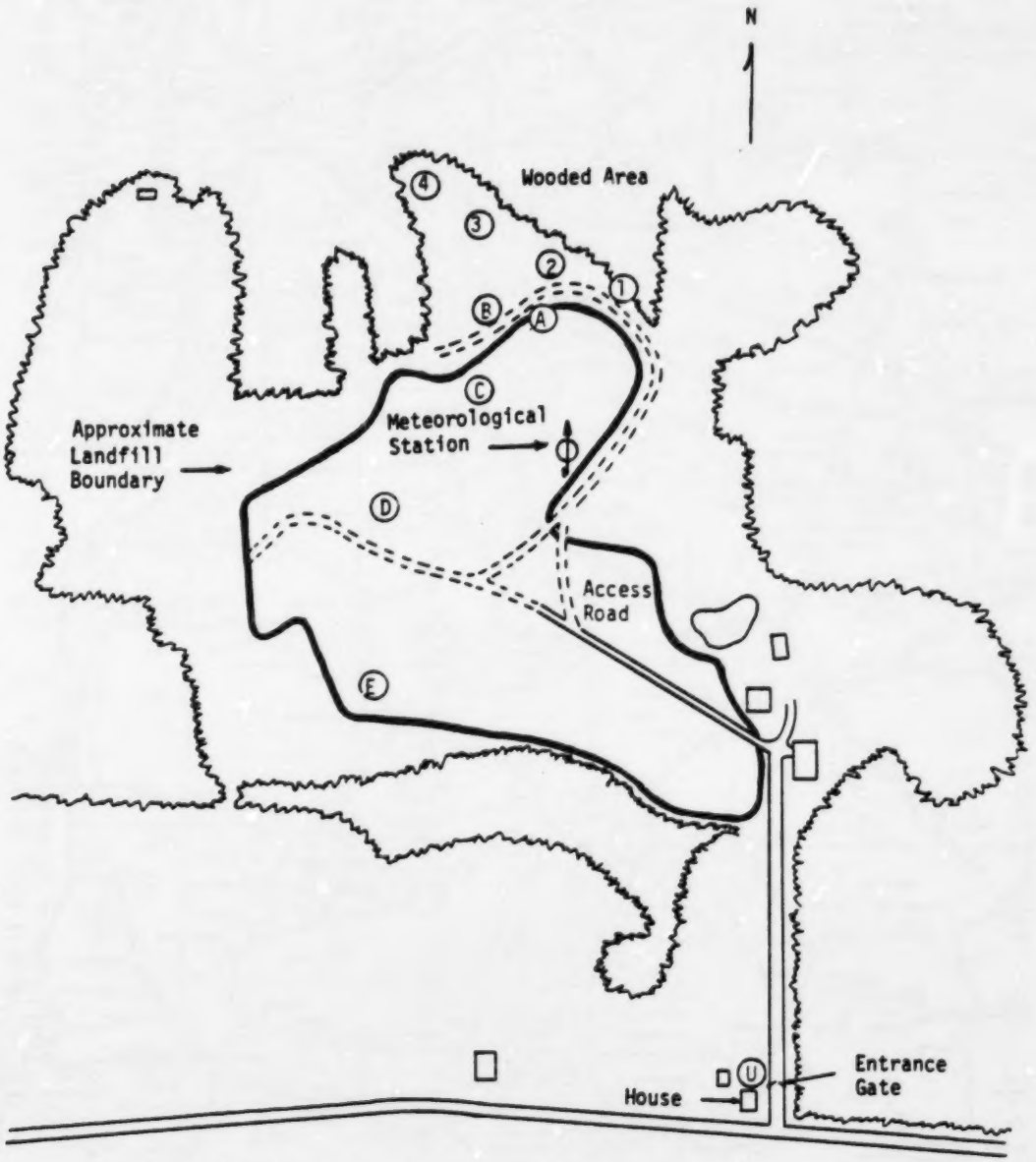


(1) Lemon Lane Landfill (previous study site)

(2) Neal's Landfill

(3) Neal's Dump

Figure 1. Location of landfill sites.



Approximate Distances:

1	to	2 - 43 m	A	to	2 - 12 m
2	to	3 - 46 m	C	to	4 - 64 m
3	to	4 - 27 m			

Figure 2. Monitoring locations at Neal's Landfill.

Neal's Dump

Neal's Dump is located in Owen County, directly off Pottersville Road, approximately 4 miles south of Spencer, IN. The site is approximately 21 driving miles west-northwest of Bloomington, IN. It is located on privately-owned property and encompasses an area of approximately 100 x 200 ft (~0.5 acres). The site is heavily overgrown with weeds and small brush. Woods border the north and west perimeters of the site. Several residences (houses and house trailers) along Potterville Road are situated on properties which border the east side of the landfill. Visual surveys have identified two small areas on the landfill site where PCB-containing capacitors are visible at ground level.

PCB monitoring at Neal's Dump was performed at three of the four previous sampling locations shown in Figure 3. Location A was a small area (~1 m^2) on the landfill where approximately three capacitors were visible prior to the remedial cleanup. Sampling Location DW was near a mobile home which is situated approximately east of the landfill area. Location U was near a mobile home situated south and generally upwind of the landfill area. Distances between the sampling locations are shown in Figure 3. Location B was a small hot spot area on the landfill which was used as a sampling location in the pre-cleanup monitoring program.

EQUIPMENT

PCB Sampling Systems

The PCB field monitoring was performed using low-volume and high-volume sampling systems developed and evaluated by Lewis, et al.[2,3,4] The components of the low volume sampling system, (shown in Figure 4) consist of a DuPont P-4000A, battery-operated, constant flow sampling pump and a polyurethane foam (PUF) cartridge to remove PCBs from the sampled air. The pumps operate on battery power for at least 8 hours at approximately 3.8 L/min; the flow rate which was used for the PCB sampling. LED indicators in the unit show battery charge level, low flow during sampling, and elapsed sampling time.

The sampling cartridges consist of a 20 mm (i.d.) x 10 cm long borosilicate glass tube into which is fitted, under slight compression, a 22 mm dia. x 7.6 cm long cylinder of PUF. The exit end of the glass envelope is drawn down to 7 mm (o.d.) to permit coupling the PUF cartridge to the pump inlet with a section of Tygon tubing.

The components of the EPA high volume sampler are shown in Figure 5. The system consists of a conventional high volume sampler modified by addition of an inlet head which accommodates a PUF sampling cartridge. The sampling head is comprised of an aluminum housing which holds a 10 cm diameter particulate filter (Pallflex 2500 QAST quartz) followed by a glass sampling cartridge containing a PUF plug. The sampling cartridge is constructed from a 60 mm i.d. x 125 mm borosilicate glass cylinder, into which is fitted, under a slight compression, a 62 mm o.d. x 7.6 cm PUF plug.

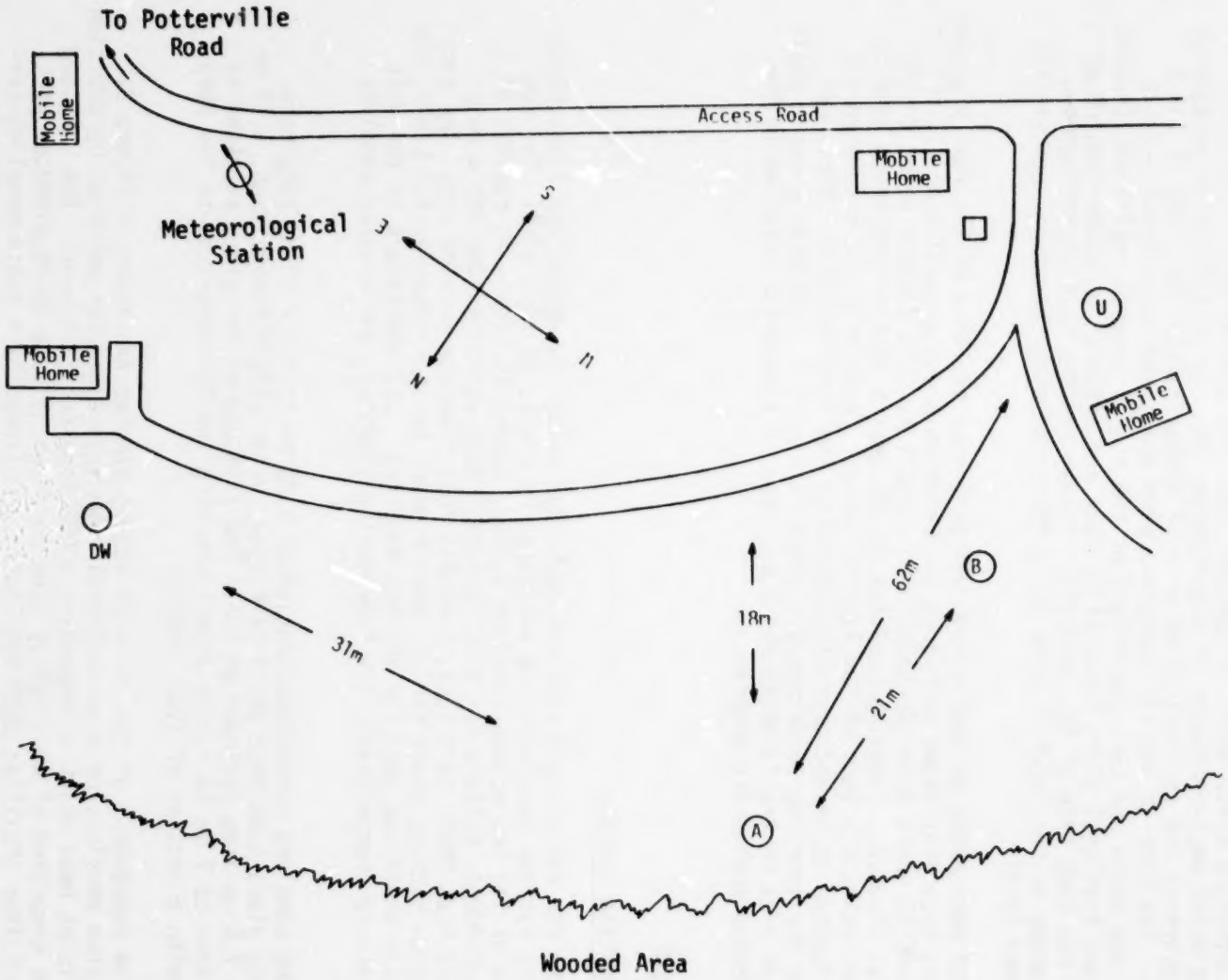


Figure 3. Monitoring locations at Neal's Dump.

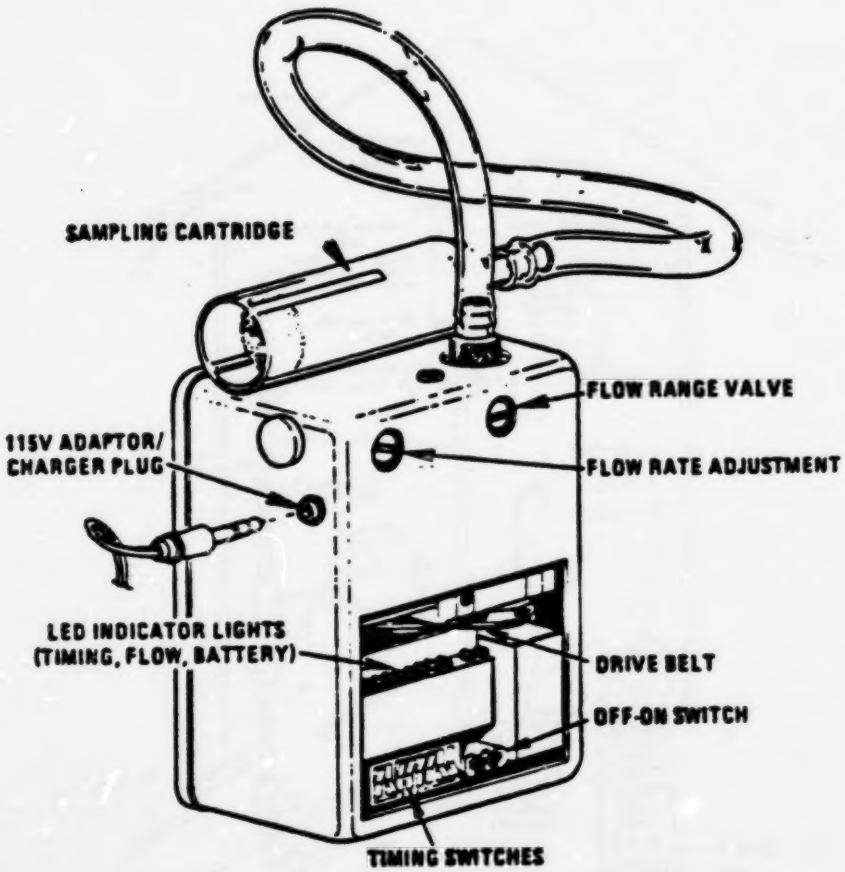


Figure 4. Low volume PCB sampler.

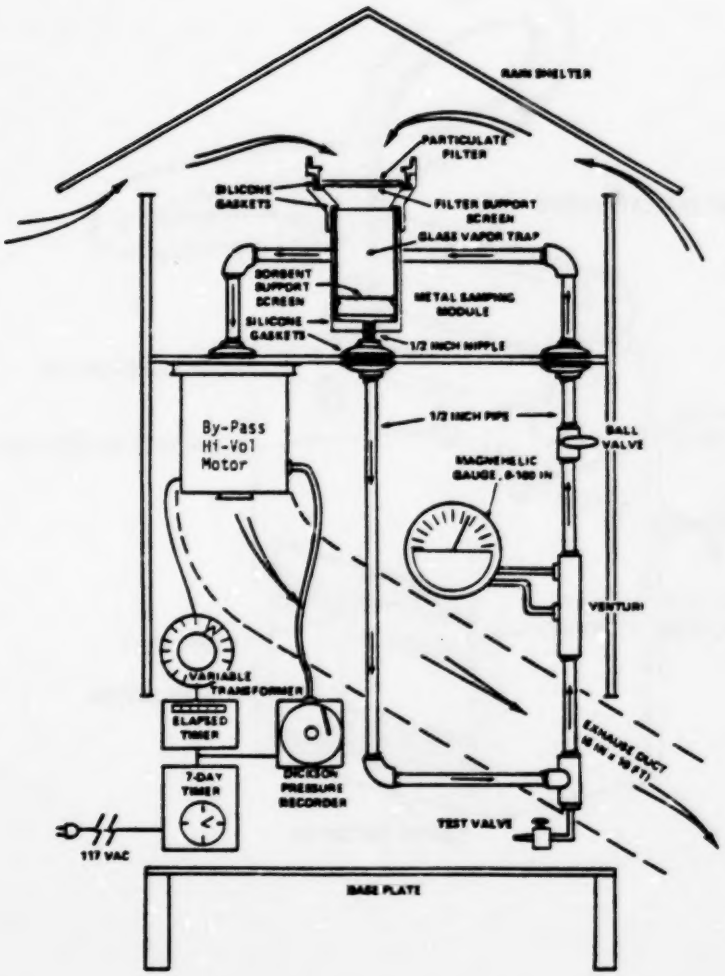


Figure 5. EPA high volume ambient air sampler.

The PUF plug is held in place by a screen supported on indentations near the bottom of the glass cylinder. Silicone rubber gaskets are used at each end of the cartridge to seal it in the sampler head. The conventional high volume sampler motors were replaced with a by-pass type for this study. This eliminated sampler failures encountered in the previous study due to overheating of the throttled-down conventional high volume motors.

For PCB sampling, the high volume units are operated at a flow rate of approximately 0.226 m^3/min (~8 cfm). A calibrated venturi tube with attached Magnehelic gauge provides a measure of the sampler flow rate. Other components in the system include: a) a valve to regulate flow, b) a Variac to control motor speed and c) an elapsed timer. A duct attached to the motor was used to direct the exhaust downwind from the sampler. At remote locations where line power was not available, the high volume samplers were operated from 1500 W gasoline-powered motor generators placed approximately 10 m downwind from the high volume sampling units. The motor generators were fitted with 5-gallon gasoline tanks to permit operation for about 18 hours between refueling.

Meteorological Stations

Continuous measurements of wind speed, wind direction and ambient temperature were obtained with Meterology Research, Inc. portable weather stations. One station was operated at Neal's Landfill and another system was operated at Neal's Dump during the sampling periods at the respective sites.

Relative humidity was determined from wet/dry-bulb temperature measurements.

PCB MONITORING PROCEDURES

As in the previous study, three different sampling procedures: (i.e.) a) low-volume, b) vertical profile and c) high-volume, were used to measure ambient air PCB concentrations and emission patterns on and in the vicinity of the landfill sites. These procedures were adapted from the protocol developed by Lewis, et al.[5,6] for monitoring hazardous waste sites.

DuPont P-4000A battery-operated, low volume samplers (flow rate ~3.8 L/min) were used to sample the ambient air at hot spots on the landfill sites and at upwind locations. The samplers were positioned with inlets of the PUF cartridges at 1.8 m above ground level. Sampling at hot spots was performed immediately downwind of the hot spot area over 8-hr day-time periods from approximately 0900 to 1700 hrs CDT.

Measurements of the vertical PCB concentration profiles were performed with a vertical array of five DuPont low volume samplers. The array was positioned directly over a hot spot area with inlets of the PUF cartridges at 2, 30, 60, 120, and 180 cm above ground level. Sampling was performed, for approximately 8-hr periods, starting at ~0900 and terminating at ~1700 hrs CDT.

EPA high volume systems (flow rate ~8 cfm) were used to collect approximately 24-hr samples upwind of the sites, at hot spots on the sites, and along the downwind perimeter of the sites. The EPA samplers were situated with the inlets approximately 1.2 m above ground level and were located, to the extent possible, in areas where air flow was unrestricted in the windward direction.

The types and locations of samples collected at each site are summarized in Table 1 and discussed in the following sections. Detailed descriptions of the low- and high-volume sampling procedures are provided in Appendix A.

Neal's Landfill

Monitoring at Neal's Landfill was conducted on July 24, 25, 27, and 28, 1984. The following sampling was performed each day of the four-day monitoring program. Monitoring with low volume samplers was performed at three different hot spot locations on the site. Vertical profile measurements were made at one hot spot. High volume samples were obtained at one upwind location, one hot spot area on the site, and at three locations along the downwind perimeter of the site. High volume samples were collected for 24-hr periods at the hot spot location and at the three downwind locations. Motor generator units were used to provide electrical power for the high volume samplers operated at the hot spot and along the downwind perimeter of the site. Line power from a nearby residence was used to operate the upwind high volume sampler.

TABLE 1. SAMPLING PROGRAM SUMMARY

Site/Sampling Dates (1984)	Sampling Location(a)	Type of Sampling Performed(b)
Neal's Landfill July 24, 25, 27, and 28	HS-A	8hrLV, 8hrVP
	-C	8hrLV, 24hrHV, 8hrVP
	-E	8hrLV
	DW-2	24hrHV
	-3	24hrHV
	-4	24hrHV
	UW	24hrHV
Neal's Dump July 25 and 27	HS-A	8hrLV, 24hrHV
	DW	24hrHV
	UW	24hrHV

(a) HS - hot spot, DW - downwind, and UW - upwind.
(b) LV - DuPont low volume sampler, HV - EPA high volume sampler, and VP - in-line vertical array of five DuPont low volume samplers.

Neal's Dump

Monitoring at Neal's Dump was performed concurrently with the sampling activities at Neal's Landfill on July 25 and 27, 1984. The following sampling was performed each day of the two-day monitoring program. Low volume sampling was performed at one hot spot on the site and 24-hr high volume samples were obtained at one upwind location, one hot spot on the site, and one downwind location. The upwind and downwind high volume samplers were operated off line power from nearby residences. A motor generator unit was used to supply power to the sampler operated at the hot spot on the landfill. Vertical profile measurements were not performed at Neal's Dump.

SAMPLE HANDLING

Strict chain-of-custody procedures, as described in the NEIC Manual[7], were employed to the extent possible in all sample handling activities associated with this study. On-site visual surveillance was maintained during all daytime sampling periods to ensure that there was no tampering with the sampling systems. The high volume units used for 24 hr sampling were sealed with locks during unattended nighttime operation.

Immediately after removal from the samplers, all PUF cartridges coded with a unique sample number were returned to sealed glass bottles. The bottle caps were then sealed with chain-of-custody tape and stored in an ice chest at about 4°C until shipment to Southwest Research Institute (SwRI), San Antonio, Texas; for PCB analysis. All transfers of clean PUF cartridges and field samples were accompanied by chain-of-custody forms.

PCB ANALYSIS PROCEDURE

Analysis for PCBs in the PUF cartridges (and high volume filters) was performed according to the procedure described in the EPA Manual of Analytical Methods[8]. The steps in the analysis procedure included; a) Soxhlet extraction of the foam plugs (and filters in the case of high volume samplers) with 5 percent ether in hexane; b) concentration of the extract to 1 mL and c) determination of PCBs in an aliquot of the extract by electron capture-gas chromatography using EPA Method 608[9]. Identification and quantification of Aroclor 1242 and 1260 in the samples was performed by the technique described by Webb and McCall[10].

PCB analyses were performed by SwRI. A stepwise description of the analytical procedure which was used is given in Appendix B.

METEOROLOGICAL MEASUREMENTS

Measurements of wind speed, wind direction and ambient temperature were performed with Meteorological Research, Inc. (MRI) portable weather stations.

One unit was located at Neal's Landfill and a second unit was used to collect meteorological data at Neal's Dump. Strip chart data from the meteorological systems was manually reduced to obtain hourly averages. Relative humidity data were obtain from wet/dry-bulb temperature measurements made periodically during daytime sampling periods.

SECTION 5

RESULTS AND DISCUSSION

The PCB concentrations in ambient air, measured at locations on Neal's Landfill/Dump and in their vicinity after the interim remedial cleanup, are shown in Tables 2 and 3 respectively. Field sampling data associated with collection of the samples at each site are given in Appendix C. Meteorological data recorded during the field study are presented in Appendix F.

As shown in Table 4, post-cleanup PCB levels measured at hot spots on the sites, show a decrease from the pre-cleanup levels. However, at HS-A and HS-C on Neal's Landfill and HS-A on Neal's Dump, there appears to be residual contamination which gives rise to airborne PCB concentrations that are slightly above background levels.

In general, there is very little difference in pre- and post-cleanup PCB levels measured at the downwind locations at the two landfills. The pre- and post-cleanup levels measured upwind at Neal's Dump were approximately the same. PCB levels observed upwind of Neal's Landfill during the post-cleanup monitoring program were higher than those measured during the pre-cleanup monitoring.

During the post-cleanup monitoring period, maximum temperatures were in the range of 25 to 28°C and there was frequent rainfall. In contrast, maximum temperatures during the pre-cleanup monitoring period were frequently in excess of 38°C and there was an absence of rainfall.

TABLE 2. RESULTS OF PCB MONITORING AT NEAL'S LANDFILL

Sampling Date	Sampling Location	Sample Type	Sampling Period, Hrs CDT		Sampling Time, min	Average Sampling Rate, L/min(b)	Total Sample Volume, scm	PCB Collected, µg	PCB Concentration in Ambient Air, µg/scm(c)
			Start	Stop(a)					
7/24/84	HS-A	8hr LV	0946	1746	480	3.653	1.75	1.5	0.9
		8hr LV	0946	1746	480	3.530	1.69	2.4	1.4
		VP-2	0950	1750	480	3.493	1.68	5.4	3.2
		VP-30	0950	1750	480	3.639	1.75	3.2	1.8
		VP-60	0950	1750	480	3.610	1.73	2.1	1.2
		VP-120	0950	1750	480	3.493	1.68	2.3	1.4
		VP-180	0950	1750	480	3.542	1.70	0.6	0.4
	HS-C	8hr LV	0956	1757	481	3.640	1.75	4.4	2.5
		24hr HV	0913	0803*	1370	227	311	1200	3.9
		24hr HV	0916	0803*	1367	227	310	1500	4.8
		VP-2	1000	1759	479	3.623	1.74	20.0	11.5
		VP-30	1000	1759	479	3.598	1.72	10.0	5.8
		VP-60	1000	1759	479	3.641	1.74	8.8	5.1
		VP-120	1000	1759	479	3.394	1.63	5.1	3.1
		VP-180	1000	1759	479	3.559	1.70	4.3	2.5
	HS-E	8hr LV	1007	1808	481	3.523	1.69	ND (<0.08)	<0.05
	UW	24hr HV	0841	0745*	1384	227	314	57	0.2
	DW-2	24hr HV	-	-	-	-	-	-	(d)
	DW-3	24hr HV	0923	0827*	1384	227	314	370	1.2
	DW-4	24hr HV	0934	0840*	1386	227	315	170	0.5

TABLE 2. (Continued)

Sampling Date	Sampling Location	Sample Type	Sampling Period, Hrs CDT Start	Sampling Period, Hrs CDT Stop[a]	Sampling Time, min	Average Sampling Rate, L/min[b]	Total Sample Volume, scm	PCB Collected, µg	PCB Concentration in Ambient Air, µg/scm[c]
7/25/84	HS-A	8hr LV	0858	1657	479	3.799	1.82	-	(e)
		8hr LV	0858	1657	479	3.753	1.80	1.4	0.8
		VP-2	0902	1659	477	3.620	1.73	5.1	2.9
		VP-30	0902	1659	477	3.799	1.81	2.4	1.3
		VP-60	0902	1659	477	3.663	1.75	2.0	1.1
		VP-120	0902	1659	477	3.672	1.75	1.4	0.8
		VP-180	0902	1659	477	3.657	1.74	0.9	0.5
	HS-C	8hr LV	0907	1705	478	3.765	1.80	3.0	1.7
		24hr HV	0822	0750*	1408	227	320	990	3.1
		24hr HV	0822	0750*	1408	227	320	1300	4.1
		VP-2	0911	1707	476	3.729	1.78	38.0	21.3
		VP-30	0911	1707	476	3.784	1.80	8.1	4.5
		VP-60	0911	1707	476	3.774	1.80	3.1	1.7
		VP-120	0911	1707	476	3.774	1.80	3.9	2.2
		VP-180	0911	1707	476	3.666	1.75	3.8	2.2
	HS-E	8hr HV	0917	1715	478	3.777	1.81	ND (<0.08)	<0.04
	UW	24hr HV	0754	0740*	1426	227	323	64	0.2
	DW-2	24hr HV	-	-	-	-	-	-	(d)
	DW-3	24hr HV	0838	0800*	1402	227	318	270	0.8
	DW-4	24hr HV	0849	0757*	1388	227	315	180	0.6

TABLE 2. (Continued)

Sampling Date	Sampling Location	Sample Type	Sampling Period, Hrs CDT Start	Sampling Period, Hrs CDT Stop[a]	Sampling Time, min	Average Sampling Rate, L/min[b]	Total Sample Volume, scm	PCB Collected, µg	PCB Concentration in Ambient Air, µg/scm[c]
7/27/84	HS-A	8hr LV	0828	1628	480	3.639	1.75	1.1	0.6
		8hr LV	0828	1628	480	3.642	1.75	1.0	0.6
		VP-2	0831	1630	479	3.668	1.76	5.2	3.0
		VP-30	0831	1630	479	3.680	1.76	2.1	1.2
		VP-60	0831	1630	479	3.682	1.76	1.7	1.0
		VP-120	0831	1630	479	3.636	1.74	1.6	0.9
		VP-180	0831	1630	479	3.654	1.75	1.0	0.6
	HS-C	8hr LV	0836	1636	480	3.712	1.78	3.0	1.7
		24hr HV	0817	0825*	1448	227	329	1200	3.6
		24hr HV	0817	0825*	1448	227	329	1300	4.0
		VP-2	0839	1637	478	3.670	1.75	26.0	14.9
		VP-30	0839	1637	478	3.712	1.77	10.0	5.6
		VP-60	0839	1637	478	3.697	1.77	9.1	5.1
		VP-120	0839	1637	478	3.721	1.78	3.9	2.2
		VP-180	0839	1637	478	3.689	1.76	3.1	1.8
	HS-E	8hr LV	0847	1647	480	3.637	1.75	ND (<0.08)	<0.05
	UW	24hr HV	0751	0800*	1449	227	329	97	0.3
	DW-2	24hr HV	0811	0815*	1444	227	328	350	1.1
	DW-3	24hr HV	0820	0837*	1457	227	331	280	0.8
	DW-4	24hr HV	0822	0847*	1465	227	333	140	0.4

TABLE 2. (Continued)

Sampling Date	Sampling Location	Sample Type	Sampling Period, Hrs CDT Start	Sampling Period, Hrs CDT Stop[a]	Sampling Time, min	Average Sampling Rate, L/min[b]	Total Sample Volume, scm	PCB Collected, µg	PCB Concentration in Ambient Air, µg/scm[c]
7/28/84	HS-A	8hr LV	0901	1701	480	3.803	1.83	0.8	0.4
		8hr LV	0901	1701	480	3.663	1.76	0.7	0.4
		VP-2	0904	1704	480	3.636	1.75	4.1	2.3
		VP-30	0904	1704	480	3.660	1.76	1.9	1.1
		VP-60	0904	1704	480	3.660	1.76	1.5	0.9
		VP-120	0904	1704	480	3.697	1.77	1.2	0.7
		VP-180	0904	1704	480	3.721	1.79	0.8	0.4
	HS-C	8hr LV	-	-	-	-	-	-	(f)
		24hr HV	0835	0827*	1432	227	325	1100	3.4
		24hr HV	0835	0827*	1432	227	325	1500	4.6
		VP-2	0910	1711	481	3.648	1.75	29	16.6
		VP-30	0910	1711	481	3.689	1.77	7.3	4.1
		VP-60	0910	1711	481	3.651	1.76	6.2	3.5
		VP-120	0910	1711	481	3.645	1.75	2.9	1.7
		VP-180	0910	1711	481	3.736	1.80	2.7	1.5
	HS-E	8hr LV	0919	1723	484	3.651	1.77	ND (<0.08)	<0.05
	UW	24hr HV	0805	0808*	1443	227	327	72	0.2
	DW-2	24hr HV	0835	0827*	1432	227	325	450	1.4
	DW-3	24hr HV	0845	0835*	1430	227	325	280	0.9
	DW-4	24hr HV	0852	0835*	1421	227	323	140	0.4

FOOTNOTES FOR TABLE 2.

(a) Asterisk indicates that stop time was on the following day, i.e., sampling time was ~24 hours.

(b) Liters/minute at 25 C, 760 mm Hg.

(c) Reported as micrograms of Aroclor 1242 per standard cubic meter (25 C, 760 mm Hg).

(d) Motor generator failed, sample void.

(e) Sample lost during analysis.

(f) Support pole fell over; sample void.

TABLE 3. RESULTS OF PCB MONITORING AT NEAL'S DUMP

Sampling Date	Sampling Location	Sample Type	Sampling Period, Hrs CDT		Sampling Time, min	Average Sampling Rate, L/min[b]	Total Sample Volume, scm	PCB Collected, µg	PCB Concentration in Ambient Air, µg/scm[c]
			Start	Stop[a]					
7/25/84	HS-A	8hr LV	0904	-	-	-	-	-	(d)
		8hr LV	0904	1704	480	3.669	1.76	1.6	0.9
		24hr HV	0837	(e)	625	227	142	400	2.8
		24hr HV	0836	(e)	624	227	142	390	2.7
	UW	24hr HV	0812	0806*	1434	227	326	60	0.2
	DW	24hr HV	0823	0832*	1449	227	329	45	0.1
7/27/84	HS-A	8hr LV	0852	1652	480	3.675	1.76	1.5	0.9
		8hr LV	0852	1652	480	3.694	1.77	1.5	0.8
		24hr HV	0836	0837*	1441	227	327	980	3.0
		24hr HV	0836	0837*	1441	227	327	1000	3.1
	UW	24hr HV	0821	0823*	1442	227	327	48	0.1
	DW	24hr HV	0843	0854*	1451	227	329	41	0.1

(a) Asterisk indicates that stop time was on the following day, i.e., sampling time was ~24 hours.

(b) Liters/minute at 25 C, 760 mm Hg.

(c) Reported as micrograms of Aroclor 1242 per standard cubic meter (25 C, 760 mm Hg).

(d) Sample pump failed.

(e) Motor generator failed, sampling time determined from elapsed timer.

TABLE 4. COMPARISON OF PRE- AND POST-CLEANUP MONITORING DATA

Sampling Location	Sample Type	Range of PCB Concentrations (µg/SCM) Found	
		Pre-Cleanup	Post-Cleanup
Neal's Landfill			
HS-A	8hr LV	5.1-11	0.4-1.4
	VP-2cm	552-1053	2.3-3.2
	VP-30cm	56-120	1.1-1.8
	VP-60cm	30-49	0.9-1.2
	VP-120cm	10-23	0.7-1.4
	VP-180cm	6.4-13	0.4-0.6
HS-C	8hr LV	5.3-12	1.7-2.5
	24hr LV	5.2-14	3.1-4.8
	VP-2cm	941-1108	11.5-21.3
	VP-30cm	111-157	4.1-5.8
	VP-60cm	40-62	1.7-5.1
	VP-120cm	15-21	1.7-3.1
	VP-180cm	8.6-16	1.5-2.5
HS-E	8hr LV	7.3-18	ND(<0.04)
UW	24hr HV	0.08-0.09	0.2-0.3
DW-2	24hr HV	0.8-1.8	1.1-1.4
DW-3	24hr HV	0.8-1.8	0.8-1.2
DW-4	24hr HV	0.3-0.7	0.4-0.6
Neal's Dump			
HS-A	8hr LV	7.9-19	0.8-0.9
	24hr HV	23-61	2.7-3.1
UW	24hr HV	0.1-0.2	0.1-0.2
DW	24hr HV	0.1-0.2	0.1

SECTION 6

QUALITY ASSURANCE DATA SUMMARY

Quality control and quality assurance procedures were implemented in this study in accordance with a formal plan approved by the Quality Assurance Division (QAD), EPA/RTP[11]. The QC/QA procedures were designed to provide quality control of all steps in the PCB measurements and to permit quantitative assessment of data quality. The QC/QA data obtained during the study are summarized in the following sections.

FLOW CALIBRATIONS

Low Volume Sampling Pumps

The Du Pont P-4000A sampling pumps were calibrated with a Du Pont calibrator system. The calibrator system consists of a 500 cc bubble tube and a Magnehelic flow meter to measure flow rate and a Magnehelic pressure gauge and a needle valve to introduce a flow resistance to check the constant flow performance of the pumps.

Calibration of the pumps was performed twice each sampling day: in the morning before the start of the sampling period and in the evening after termination of sampling. During the morning calibration, the pumps were also checked to determine that: a) the battery was fully charged, b) that constant flow was maintained at a 254 mm Hg pressure drop and that c) the low flow indicator functioned properly.

The flow calibration data obtained during the study are presented in Appendix D. The differences between the pre- and post-sampling flow calibrations ranged from +1.4 to -5.8 percent. Generally, flows measured after sampling were slightly less than those determined before sampling due possibly to discharge of the batteries during sampling. With the exception of three occasions, all the pre- and post-sampling flow calibrations 60 determinations) agreed to within $\pm$ 5 percent.

High Volume Samplers

Calibration of the EPA high volume samplers was performed before starting and at the end of the field sampling program. Calibration of the high volume samplers was performed with an orifice assembly obtained from General Metal Works. The calibration curve supplied with the orifice is shown in Appendix D. Calibration data for the high volume samplers is also given in Appendix D.

FLOW AUDIT

A flow audit of the samplers used in the study was performed by the Environmental Monitoring Systems Laboratory, Quality Assurance Division. The audit was conducted on July 24 and 25 during actual field sampling operations at Neal's Landfill and Neal's Dump. A copy of the report which describes the audit procedures and results is provided in Appendix E. Based on a pre- and post-sampling audit of 16 Du Pont pumps (32 audit flow checks), the average difference between the operator and audit flow rate values was -2.6 percent, with a maximum difference of only -3.7 percent. The average difference between the BCL and audit flow rates obtained from the audit of five high volume samplers (10 audit flow checks) was +7.2 percent. With the exception of one value (+11.25 percent), all audit and operator flow rates agreed within ±10 percent.

FIELD BLANKS

Field blanks were analyzed with the ambient air samples collected at each landfill site. The blanks, which were low volume and high volume PUF cartridges carried throughout all field operations except sampling. The PCB level in all the field blanks was below a minimum detectable concentration of 0.02 µg Aroclor 1242.

STANDARDS ANALYSIS

A set of samples consisting of PUF cartridges, spiked with known quantities of Aroclor 1242, were analyzed during the study. They were prepared by Battelle Columbus Laboratories and submitted to SwRI for analysis along with the ambient air samples. The set of standards contained six, clean, unused, PUF cartridges (three low volume and three high volume) spiked with either 0.95, 4.72, or 9.44 µg of Aroclor 1242. National Bureau of Standards/ Standard Reference Material (NBS/SRM) 1581 (Aroclor 1242 in transformer oil) was used to prepare the standards.

The results obtained from analysis of the standards are shown in Table 5. Recoveries determined for individual samples ranged from 84 to 105 percent. Variations in recovery do not appear to be correlated with either cartridge type (low volume or high volume) or concentration over the spiking range. The median recovery from all the low volume cartridges and all the high volume cartridges was 89 and 100 percent, respectively.

COLLOCATED MONITORING DATA

During the field study, pairs of low volume (LV) and high volume (HV) samplers were operated for the same time period at the same sampling location to estimate the reproducibility of the measurement methods.

TABLE 5. SPIKED CARTRIDGE ANALYSIS RESULTS

Cartridge Type	Aroclor 1242 Added, µg	Aroclor 1242 Found, µg	Recovery, %
LV	9.44	9.7	103
LV	0.95	0.8	84
LV	4.72	4.2	89
HV	0.95	1.0	105
HV	4.72	4.7	100
HV	9.44	8.7	92

The data obtained from collocated low volume samplers is shown in Table 6. Good agreement between the pairs of measurements was obtained especially in view of the low PCB levels.

PCB concentrations measured by collocated high volume samplers are given in Table 7. The median difference calculated from all the paired high volume sampler measurements is 15.6 percent. The results show excellent agreement between the sampler pairs, considering that the units were positioned approximately one meter apart (to minimize sampler interaction) and spatial variations in airborne PCB levels could contribute to differences observed by the two systems.

TABLE 6. COLLOCATED LOW VOLUME SAMPLER DATA[a]

Site	Sampling Date	Sampling Location	PCB Conc. in Air, µg/scm	Percent Difference in Pair
Neal's Landfill	7/24/84	HS-A	0.9 1.4	43.5
	7/27/84	HS-A	0.6 0.6	0.0
	7/28/84	HS-A	0.4 0.4	0.0
Neal's Dump	7/27/84	HS-A	0.9 0.8	11.8
			Median	5.9

(a) Separation between sampling cartridge inlets was approximately 15 cm.

TABLE 7. COLLOCATED HIGH VOLUME SAMPLER DATA(a)

Site	Sampling Date	Sampling Location (Type)	PCB Conc. in Air, µg/scm	Percent Difference in Pair
Neal's Landfill	7/24/84	HS-C	3.9 4.8	20.7
	7/25/84	HS-C	3.1 4.1	27.8
	7/27/84	HS-C	3.6 4.0	10.5
	7/28/84	HS-C	3.4 4.6	30.0
Neal's Dump	7/25/84	HS-A	2.8 2.7	3.6
	7/27/84	HS-A	3.0 3.1	3.3
			Median	15.6

(a) Separation between sampler inlets was approximately 1 meter.

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APPENDIX A

OPERATING PROCEDURES FOR DU PONT LOW VOLUME AND EPA HIGH VOLUME SAMPLERS

Step-wise procedures used to perform sampling with the Du Pont low volume and EPA high volume sampling systems are given below. The procedures follow the protocol that Lewis, et al[5,6] have developed for PCB monitoring.

Du Pont Low Volume Samplers

(1) Calibrate the flow rate of the Du Pont pumps in the morning before starting the day's sampling activities.

(2) At the field site, place pumps at designated sampling locations. Record pump S/N and corresponding sampling location I.D. on the Sampling Data Form (Figure A-1).

(3) a) Using latex gloves*, remove a clean PUF cartridge from its sample bottle, carefully unwrap the aluminum foil from the cartridge. b) Fold aluminum foil, replace in sample bottle, and tightly close the bottle cap. c) Connect the PUF sampling cartridge to the DuPont pump sampling inlet using a short piece (12-18 in.) of Tygon tubing. d) Record the PUF cartridge number on Sampling Data Form.

(4) a) Using metal three-prong clamps that have been rinsed with B&J hexane, mount the PUF cartridges on the sampler support rod in a vertical position with the inlet pointing downward. b) Position cartridge inlets as follows: up-wind and "hot-spots" - 1.8 m above ground level, vertical profiles - 2, 30, 60, 120, and 180 cm above ground level. c) Record cartridge height above ground on Sampling Data Form.

(5) a) Turn pumps on and begin sampling period at 0900 hrs CDT (±30 minutes). b) Record starting clock time on Sampling Data Form. c) During the sampling period check pumps at least every 2 hours for proper operation. d) Record any abnormal conditions on Sampling Data Form.

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* Note: Clean latex gloves must be worn at all times when handling the PUF cartridges.

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site _____ Date _____ Performed by _____

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cart. No.	Sampling Period, hr CDT		Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
				Start	Stop				

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by _____ Date _____

Figure A-1. Du Pont low volume PCB sampling data form.

(6) a) After sampling for 8 ±0.5 hrs, terminate sampling period by turning pumps off. b) Record clock time that pump was turned off on Sampling Data Form. c) Just before turning pumps off, push test button on pump and check low flow light and the elapsed time indicator lights. If low flow light comes on, it indicates that a low flow condition existed during the sampling period, e.g., Tygon tubing crimped, cartridge plugged, pump stopped, etc). d) Record results of the low flow check on Sampling Data Form. e) Record elapsed time from the pump timer on the Sampling Data Form as a check on the clock time.

(7) As soon as possible after termination of sampling, remove the PUF cartridge from the Tygon sample line (using latex gloves), wrap cartridge in its original aluminum foil wrapping, and place in the original sample bottle. Cap tightly, label bottle with sampling data and sample I.D., and seal the bottle cap with a strip of "Evidence Tape".

(8) After recovery, store all samples on ice in a locked ice chest. Maintain storage under these conditions until samples are shipped to SwRI for analysis.

(9) Re-calibrate the flow rate of the DuPont pumps after completing the day's sampling activities.

EPA Samplers

(1) Place calibrated EPA hi-vol units at designated sampling locations. Record the hi-vol S/N and corresponding sampling location I.D. on the Sampling Data Form (Figure A-2).

(2) Using latex gloves, remove a clean PUF cartridge from its sample bottle and carefully unwrap the aluminum foil from the cartridge. Fold aluminum foil, replace in sample bottle, and tightly close the bottle cap.

(3) Insert the PUF cartridge into the hi-vol sampler head, making sure that both the top and bottom silicone rubber gaskets are in place. Attach the top section of sampler head and tighten to seal the PUF cartridge in place. Place a new Pallflex 2500 QAST quartz fiber filter in the top of the sampling head and seal in place with the retaining ring. Record PUF cartridge number and indication that new filter was installed on Sampling Data Form.

(4) Turn the hi-vol unit on and begin sampling period at 0800 hrs CDT (±60 minutes) for 24-hour samples. Check to ensure that the hi-vol motor exhaust duct is directed downwind. Record starting clock time, elapsed-timer reading and Variac setting on the Sampling Data Form. After the initial 5 minutes of operation, obtain a reading from the Magnehelic gauge and record the clock time and gauge reading on the Sampling Data Form (Space 1).

Battelle

HIGH VOLUME PCB SAMPLING DATA

Site _____ Date _____ Performed by _____

Sampler S/N	Sampling Location ID	Raw Filter (,)	PUF Cart. No.	Vernier setting	Clock Time			Sampler Timer			Venturi Readings: Time/Magnahelic in. H_2O				Comments[a]
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	

(5) Monitor sampler for proper operation during the remainder of the daylight hours. Obtain a Magnehelic gauge reading on each hi-volume at approximately 6-hour intervals and record readings and clock times at which the readings were taken on the Sampling Data Form (Spaces 3 and 4).

(6) Before leaving the site in the evening, secure samplers by padlocking access doors on the units.

(7) On the following morning after an elapsed sampling time of 24 $\pm$0.5 hrs, terminate sampling period by turning the hi-vol unit off. Just before turning unit off, obtain a reading from the Magnehelic gauge and record the reading along with the clock time on the Sampling Data Form (Space 4). Record clock time the unit was turned off and the elapsed timer reading on the Sampling Data Form.

(8) As soon as possible after termination of sampling, remove the filter and PUF cartridge from the hi-vol unit sampling head. Using latex gloves, remove the filter retaining ring and with a hexane-rinsed metal spatula remove filter. Fold the filter in half with the face containing the particulate catch inward and then fold in half again. Completely wrap the filter in a piece of hexane-rinsed aluminum foil and place in the PUF cartridge bottle. Remove the PUF cartridge from sampler head, completely wrap with the original aluminum foil wrapping and place in original sample bottle. Label bottle with sampling data and sample I.D. Cap tightly, label bottle with sampling data, and seal the bottle cap with a strip of "Evidence Tape".

(9) After recovery, store all samples on ice in a locked ice chest. Maintain storage under these conditions until samples are shippped to SwRI for analysis.

APPENDIX B

PCB ANALYSIS PROCEDURE

PUF Cartridge Cleanup

All PUF cartridges were cleaned to remove contamination and interferences prior to use for ambient air monitoring. The clean up was performed by Soxhlet extraction of each PUF plug with 5% ether/hexane for a period of at least 16 hours according to Steps (10) through (16) of the PCB analysis procedure. One PUF plug from each batch of 20 processed through the cleanup steps was re-extracted and analyzed according to the PCB analysis procedure to assure that the plugs are acceptable for field sampling.

Following clean-up, the sampling cartridges (PUF plug in a glass envelope) were wrapped in hexane-rinsed aluminum foil and then individually sealed in cleaned glass bottles (with hexane-rinsed aluminum foil liners in caps) for shipment to the field sampling site.

PCB Analysis Procedure

The PUF cartridges were analyzed for PCB's by a) Soxhlet extraction of the foam plugs as described by Lewis[2], b) concentration of the extract, and c) determination of PCB's by EPA Method 608[10]. The analyses was performed according to the following procedure.

I. Equipment and Reagents Required for PUF Sample Extraction

1. Glassware
   500 mL boiling flasks
   300 mL capacity Soxhlet extractors
   3 ball condensers
   500 mL Kuderna-Danish apparatus
   15 mL receiver tubes
   Synder columns
   Filter tubes (Corning 9480-32)
   Pre-scored (1 mL, 5mL) amber glass vials with teflon-lined caps
   9" long disposable transfer (Pasteur) pipets
   Wash all glassware with Alconox; rinse with deionized water, acetone, hexane, and deionized water; then fire in kiln (500 C)

2. Equipment
   Extraction Apparatus, Multi-Unit Heater (CMS 119-362)
   Blunt-end forceps
   Surgical tongs (approximately 12")

Steam bath
Nitrogen blow-down evaporator
Glass wool (Heater overnight at 350 C in muffle furnace)
Boiling granules (Heater overnight at 500 C in kiln)
Teflon wash bottles

3. Reagents
Burdick and Jackson, Distilled in Glass Solvents:
Acetone
Hexane
Ethyl Ether (Preserved with Ethanol)
Sodium Sulfate, 12-60 mesh, Anhydrous (Baker 5-3375) (Heated overnight at 500°C in kiln).

II. Sample Receipt and Extraction

1. Log samples in log book. Note any damage to sample or irregularities (i.e., EPA chain of custody tape broken).

2. Prepare 5% ethyl ether in hexane. Prepare by case lot of hexane. Remove 200 mL of hexane from freshly opened bottle and add 180 mL of freshly opened ethyl ether (preserved with ethanol).

3. Rinse condenser towers with 5% ether/hexane.

4. Wipe off lab bench with 5% ether/hexane.

5. Add 300 mL of 5% ether/hexane to 500 mL boiling flask. Add boiling granules (no more than 3 granules).

6. Dim lights in laboratory before removing first sample. Rinse a large sheet of aluminum foil with 5% ether/hexane. Be sure to use waste rinse container. Place foil, rinsed side up, on lab bench. Use this for forceps and tongs. Rinse forceps and tongs with 5% ether/hexane.

7. Carefully remove sampling cartridge from jar and unwrap aluminum foil. Handle cartridge minimally, placing it on its own aluminum foil wrapping.

8. Note in project log book any breakage or damage to sampling cartridge.

9. With pre-rinsed forceps, carefully remove the foam plug (PUF) from the sampling cartridge.

10. Place the PUF in the Soxhlet, and connect the Soxhlet to the 500 mL boiling flask. (If hi-vol sample, also place corresponding particulate filter in Soxhlet with PUF plug). Wet the joint with 5% ether/hexane. Place the forceps on the aluminum foil wrapping. Label the boiling flask with sample I.D.

11. Taking the pre-rinsed tongs, adjust the PUF in the Soxhlet to wedge it midway along the length of the siphon. Rinse the tongs into the Soxhlet with the 5% ether/hexane. Rinse the forceps, glass sampling cartridge, and aluminum foil wrapping with 5% ether/hexane into the Soxhlet. Place the forceps and tongs on the aluminum foil sheet. Dispose of the aluminum foil wrapping and place the glass cartridge aside for washing and recycling.

12. Connect the Soxhlet to the condenser, wetting the glass joint with 5% ether/hexane for a good seal.

13. Repeat the process for the day's samples being sure to include a solvent blank, field blank, and a control sample.

14. Check water flow to condenser towers, and turn on heating units.

15. As samples begin to boil, check Soxhlets making sure they are filling and siphoning properly (4 cycles/hour). Allow samples to cycle overnight or for a minimum of 16 hours.

16. Turn off heating units and allow samples to cool to room temperature. Be sure the lights are dim.

17. Set up Kuderna-Danish (K-D) with receiver tubes. Add one boiling granule to each set up. Label the K-D's with the sample I.D.

18. Pack filter tubes with glass wool and sodium sulfate. Place tube in neck of K-D.

19. Carefully remove Soxhlet and boiling flask from condenser tower. Drain remaining solvent into boiling flask.

20. Carefully pour sample through filter tube into K-D. Rinse boiling flask 3 times with hexane. Swirling hexane along sides of boiling flask. Once sample has drained, rinse down filter tube with hexane.

21. Attach Snyder column to K-D and rinse Snyder column to wet joint.

22. Place K-D on steam bath and evaporate sample to approximately 5 mL. Do not let sample go to dryness.

23. Remove sample from steam bath, rinsing Snyder column with a minimum of hexane. Allow sample to cool.

24. Remove sample from K-D, making sure to label receiver tube.

25. Rinse nitrogen blow down spouts with hexane and place samples so as to further concentrate. Transfer samples to pre-scored vials using transfer pipets. Rinse receiver tube 3 times making a quantitative transfer. Concentrate samples to 1 mL or per instruction from analyst.

26. Make a master list of all samples prepared, date received, and processed. Give the list and sample extracts to the GC analyst.

III. GC Analysis (EPA Method 608)

1. Analyze samples using the following GC operating conditions.

Column:	Supelcoport 100/120 mesh coated with 1.5% SP-2250/1.95% SP-2401 packed in glass (180 cm x 4 mm ID)
Carrier:	5% methane/95% Argon at 60 mL/min
Column Temperature:	200 C, isothermal
Detector:	ECD

2. Calibrate the system daily with a minimum of three injections of calibration standards which have been referenced to NBS/SRM 1581 (Aroclor 1242 in oils)

3. Inject 2-5 µL of the sample extract using the solvent-flush technique. Smaller (1.0 µL) volumes can be injected if automatic devices are employed. Record the volume injected to the nearest 0.05 µL and the resulting peak size, in area units.

4. If the peak area exceeds the linear range of the system, dilute the extract and reanalyze.

IV. Quality Control (QC)

1. Analyze one laboratory blank per each batch of 20 samples.

2. Analyze one laboratory spike per each batch of 20 samples.

APPENDIX C

FIELD SAMPLING DATA

The data recorded during the field sampling programs at Neal's Landfill and Neal's Dump are presented in this appendix.

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/24/84 Performed by Sgontz, Jr./Sgontz, Sr./Lemmon

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cert. No.	Sampling Period, hr CDT		Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
				Start	Stop				
5138	NL-LV-HSA-1	180	L58	0946	1746	480	—	No	
A092	NL-LV-HSA-2	180	L54	0946	1746	480	—	No	
5136	NL-VP-HSA-2	2	L59	0950	1750	480	—	No	
9806	NL-VP-HSA-30	30	L60	0950	1750	480	—	No	
5116	NL-VP-HSA-60	60	L53	0950	1750	480	8:00	No	
A083	NL-VP-HSA-120	120	L55	0950	1750	480	—	No	
A087	NL-VP-HSA-180	180	L56	0950	1750	480	8:05	No	
A037	NL-LV-HSC	180	L49	0956	1757	481	8:04	No	
A061	NL-VP-HSC-2	2	L50	1000	1759	479	8:00	No	
A143	NL-VP-HSC-30	30	L51	1000	1759	479	—	No	
A126	NL-VP-HSC-60	60	L52	1000	1759	479	—	No	
A121	NL-VP-HSC-120	120	L12	1000	1759	479	—	No	
A032	NL-VP-HSC-180	180	L11	1000	1759	479	—	No	
A062	NL-LV-HSE	180	L9	1007	1808	481	8:05	No	

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd F. Lemmon Date 8/14/84

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/25/84 Performed by Sgontz, Sr / Sgontz, Jr.

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cart. No.	Sampling Period, hr CDT Start	Sampling Period, hr CDT Stop	Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
A092	NL-LV-HSA-1	180	L7	0858	1657	479	8:01	No	
A037	NL-LV-HSA-2	180	L10	0858	1657	479	8:01	No	
A143	NL-VP-HSA-2	2	L8	0902	1659	477	7:59	No	
9806	NL-VP-HSA-30	30	L6	0902	1659	477	7:59	No	
5157	NL-VP-HSA-60	60	L5	0902	1659	477	7:59	No	
A087	NL-VP-HSA-120	120	L4	0902	1659	477	7:59	No	
A083	NL-VP-HSA-180	180	L3	0902	1659	477	7:59	No	
A127	NL-LV-HSC	180	L16	0907	1705	478	8:00	No	* Rain from 11:45 - 12:20
A061	NL-VP-HSC-2	2	L15	0911	1707	476	7:59	No	
4696	NL-VP-HSC-30	30	L14	0911	1707	476	7:59	No	
A089	NL-VP-HSC-60	60	L13	0911	1707	476	7:59	No	
5138	NL-VP-HSC-120	120	L17	0911	1707	476	7:59	No	
A118	NL-VP-HSC-180	180	L18	0911	1707	476	7:59	No	
A126	NL-VP-HSE	180	L19	0917	1715	478	8:00	No	

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd E. Fennon Date 8/14/84

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/27/84 Performed by Sgontz, Sr. / Sgontz, Jr.

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cart. No.	Sampling Period, hr CDT		Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
				Start	Stop				
A126	NL-LV-HSA-1	180	L48	0828	1628	480	8:00	No	
A092	NL-LV-HSA-2	180	L47	0828	1628	480	8:00	No	
A037	NL-VP-HSA-2	2	L46	0831	1630	479	8:00	No	
A089	NL-VP-HSA-30	30	L45	0831	1630	479	8:00	No	
5157	NL-VP-HSA-60	60	L44	0831	1630	479	8:00	No	
A120	NL-VP-HSA-120	120	L43	0831	1630	479	8:00	No	
5116	NL-VP-HSA-180	180	L42	0831	1630	479	8:00	No	
9806	NL-LV-HSC	180	L23	0836	1636	480	8:00	No	
A087	NL-VP-HSC-2	2	L37	0839	1637	478	8:00	No	
A118	NL-VP-HSC-30	30	L38	0839	1637	478	8:00	No	
A062	NL-VP-HSC-60	60	L39	0839	1637	478	8:00	No	
A127	NL-VP-HSC-120	120	L41	0839	1637	478	8:00	No	
5138	NL-VP-HSC-180	180	L40	0839	1637	478	8:00	No	
A143	NL-LV-HSE	180	L24	0847	1647	480	8:00	No	

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd F. Lemmon Date 8/14/84

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/28/84 Performed by Lemmon/Sgontz, Sr./Sgontz, Jr.

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cart. No.	Sampling Period, hr CDT		Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
				Start	Stop				
A089	NL-LV-HSA-1	180	L61	0901	1701	480	8:00	No	
A143	NL-LV-HSA-2	180	L66	0901	1701	480	8:00	No	
5157	NL-VP-HSA-2	2	L67	0904	1704	480	8:00	No	
5138	NL-VP-HSA-30	30	L68	0904	1704	480	8:00	No	
A126	NL-VP-HSA-60	60	L64	0904	1704	480	8:00	No	
A092	NL-VP-HSA-120	120	L63	0904	1704	480	8:00	No	
9806	NL-VP-HSA-180	180	L62	0904	1704	480	8:00	No	
A121	NL-LV-HSC	180	L70	0910	—	—	—	—	Sample void; pole fell over
A120	NL-VP-HSC-2	2	L2	0910	1711	481	8:02	No	
A118	NL-VP-HSC-30	30	L20	0910	1711	481	8:02	No	
A079	NL-VP-HSC-60	60	L65	0910	1711	481	8:02	No	* Rain from about 1:00-4:00pm
A062	NL-VP-HSC-120	120	L1	0910	1711	481	8:02	No	
A061	NL-VP-HSC-180	180	L22	0910	1711	481	8:02	No	
A037	NL-LV-HSE	180	L21	0919	1723	484	—	No	

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd E. Lemmon Date 8/15/84

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site Neal's Dump Date 7/25/84 Performed by Lemmon

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cart. No.	Sampling Period, hr CDT		Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
				Start	Stop				
A120	ND-LV-HSA-1	180	L35	0904	1204	180	—	Yes	Rain caused pump to fail } VOID
A062	ND-LV-HSA-1	180	L31	1204	1704	300	4:58	No	Replaced pump & cartridge }
A121	ND-LV-HSA-2	180	L36	0904	1704	480	7:45	No	*Sample analyzed by SwRI

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd E. Lemmon Date 8/14/84

Battelle
Columbus Laboratories

DU PONT LOW VOLUME PCB SAMPLING DATA

Site Neal's Dump Date 7/27/84 Performed by Lemmon

Sampler S/N	Sampling Location I.D.	Height Above Ground, cm	PUF Cart. No.	Sampling Period, hr CDT		Sampling Time, min	Pump Timer, hr-min	Lo Flow Indication? Yes/No	Comments[a]
				Start	Stop				
A061	ND-LV-HSA-1	180	L28	0852	1652	480	8:02	No	
A079	ND-LV-HSA-2	180	L32	0852	1652	480	8:02	No	

(a) Record any abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd F. Fitzsimmons Date 8/14/84

Battelle
Columbus Laboratories

HIGH VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/24/84 Performed by Lemmon/Sgontz, Jr./Sgontz, Sr.

Sampler S/N	Sampling Location I.D.	Blow Power (√)	PUF Cart. No.	Vernier Setting	Clock Time: Start, hr CDT	Clock Time: Stop, hr CDT	Clock Time: Min Elapsed	Sampler Timer: Start, min	Sampler Timer: Stop, min	Sampler Timer: Min Elapsed	Venturi Readings: Time/Magnehelic in. H_2O: 1	2	3	4	Comments[a]
0002	NL-HV-UW	✓	H30		0841	0745	1384	70295	71687	1392	41				
HEW2	NL-HV-DW2	✓	H26		0902	—	—	15724	—	—	42				Sample void; generator failure
EPA-94	NL-HV-HSC-1	✓	H35		0913	0803	1370	15834	17116	1282	41				
EPA-94	NL-HV-HSC-2	✓	H36		0916	0803	1367	86479	87761	1282	42				
EPA-95	NL-HV-DW3	✓	H32		0923	0827	1384	67985	69398	1413	41				
6302	NL-HV-DW4	✓	H34		0934	0840	1386	12462	13863	1401	46				
					(7/24)	(7/25)									

(a) Record any evidence of tampering with sampler and/or abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd F. Lemmon Date 8/15/84

Battelle
Columbus Laboratories

HIGH VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/25/84 Performed by Sgontz, Jr. / Sgontz, Sr.

Sampler S/N	Sampling Location I.D.	Glass Filter (√)	PUF Cart. No.	Vernier Setting	Clock Time			Sampler Timer			Venturi Readings: Time/Magnehelic in. H_2O				Comments[a]
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	
0002	NL-HV-UW	✓	H43		0754	0740	1426	71696	73123	1427	41				
EPA-94	NL-HV-HSC-1	✓	H38		0822	0750	1408	17124	18487	1363	41				
EPA-96	NL-HV-HSC-2	✓	H42		0822	0750	1408	87769	89132	1363	42				* Moderate rain from 1145-1220 (7/25/84)
EPA-95	NL-HV-DW3	✓	H41		0838	0800	1402	69401	70794	1393	41				
6302	NL-HV-DW4	✓	H37		0849	0757	1388	13865	15237	1372	46				* Hard rain from 0600-0645 (7/26/84)
					(7/25)	(7/26)									

[a] Record any evidence of tampering with sampler and/or abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked By Todd E. Simmon Date 8/15/84

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Columbus Laboratories

HIGH VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/27/84 Performed by Sgontz, Jr. / Sgontz, Sr.

Sampler S/N	Sampling Location I.D.	Glass Filter (✓)	PUF Cart. No.	Vernier Setting	Clock Time			Sampler Time			Venturi Readings: Time/Magnehelic in. H_2O				Comments[a]
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	
0002	NL-HV-UW	✓	H13		0751	0800	1449	74574	76025	1451	41				
MEW2	NL-HV-DW2	✓	H22		0811	0815	1444	16089	17538	1449	42				
EPA-91	NL-HV-HSC-1	✓	H45		0817	0825	1448	18487	19868	1401	41				
EPA-94	NL-HV-HSL-2	✓	H46		0817	0825	1448	89132	90533	1401	42				
EPA-93	NL-HV-DW3	✓	H18		0820	0837	1457	70794	72221	1427	41				
6302	NL-HV-DW4	✓	H48		0822	0847	1465	15237	16707	1470	46				
					(7/27)	(7/28)									

[a] Record any evidence of tampering with sampler and/or abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd Fr. Simmer Date 8/15/84

Battelle
Columbus Laboratories

HIGH VOLUME PCB SAMPLING DATA

Site Neal's Landfill Date 7/28/84 Performed by Lemmon/Sgontz, Jr./Sgontz, Sr.

Sampler S/N	Sampling Location I.D.	New Filter (✓)	PUF Cart. No.	Vortec Setting	Clock Time			Sampler Timer			Venturi Readings: Tube/Magnehelic in. H_2O				Comments[a]
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	
0002	NL-HV-UW	✓	H4		0805	0808	1443	76028	77475	1447	41				
NEW2	NL-HV-DW2	✓	H25		0823	0822	1439	17538	18964	1426	42				
EPA-93	NL-HV-FSC-1	✓	H17		0835	0827	1432	19888	21276	1388	41				
EPA-94	NL-HV-FSC-2	✓	H2		0835	0827	1432	90533	91921	1388	42				
EPA-95	NL-HV-DW3	✓	H21		0845	0835	1430	72221	73704	1483	41				
6302	NL-HV-DW4	✓	H6		0852	0835	1421	16707	18131	1424	46				
					(7/28)	(7/29)									

[a] Record any evidence of tampering with sampler and/or discrepancies in sampler operation, PUF cartridge condition or handling, etc.

Data Checked By Todd F. Lemmon Date 8/15/84

Battelle
Columbus Laboratories

HIGH VOLUME PCB SAMPLING DATA

Site Neal's Dump Date 7/25/84 Performed by Lemmon

Sampler S/N	Sampling Location I.D.	Rotameter Setting (✓)	PUF Cart. No.	Vernier Setting	Clock Time			Sampler Timer			Vernier Readings: Tens/Fractions in. H_2O				Comments[a]
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	
EPA-11	ND-HV-UW	✓	H44		0812	0806	1434	56969	58449	1480	43				
EPA-13	ND-HV-DW	✓	H39		0823	0832	1449	16562	18009	1447	42				
EPA-12	ND-HV-HSA-1	✓	H33		0837	–	–	69369	69994	625	41				Bad spark plug caused generator failure; sampler timer readings will be used for elapsed time
EPA-10	ND-HV-HSA-2	✓	H29		0838	–	–	8895	9519	624	40				
					(7/25)	(7/26)									

[a] Record any evidence of tampering with sampler and/or observations on sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd F. Lemmon Date 8/15/84

Battelle
Columbus Laboratories

HIGH VOLUME PCB SAMPLING DATA

Site Neal's Dump Date 7/27/84 Performed by Lemmon

Sampler SAS	Sampling Location I.D.	New Filter (✓)	PUF Cart. No.	Vernier Setting	Clock Time			Sampler Timer			Venturi Readings: Time/Magnehelic in. H_2O				Comments[a]
					Start, hr CDT	Stop, hr CDT	Min Elapsed	Start, min	Stop, min	Min Elapsed	1	2	3	4	
EPA-11	ND-HV-ULW	✓	H12		0821	0823	1442	58460	59960	1500	43				
EPA-13	ND-HV-DW	✓	H3		0843	0854	1451	19462	20912	1450	41				
EPA-12	ND-HV-HSA-1	✓	H8		0836	0837	1441	70000	71386	1386	42				
EPA-10	ND-HV-HSA-2	✓	H11		0836	0837	1441	9525	10911	1386	40				
					(7/27)	(7/28)									

(a) Record any evidence of tampering with sampler and/or abnormalities in sampler operation, PUF cartridge condition or handling, etc.

Data Checked by Todd F. Lemmon Date 8/15/84

APPENDIX D

FLOW CALIBRATION DATA

The records of daily flow rate calibration of the low volume and high volume samplers are shown in this appendix. For the DuPont pumps, the first horizontal column shows the pre-sampling calibration data and the second column shows the post-sampling calibration data. The average flow computed from the pre- and post-sampling calibrations is shown and the percentage differences between the pre- and post-test flow rate calibrations are given. A negative value indicates that the flow rate determined from the post-sampling calibration was lower than that determined from the pre-sampling calibration.

The high volume samplers were calibrated at the beginning and end of the field sampling program with an orifice obtained from General Metals, Inc. The calibration curve for the orifice is provided at the end of the appendix.

Battelle
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DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon / Sgontz, Jr. Calibrator S/N _____ Amb. Temp. AM 23°C PM 24°C

Date/Time 7/24/84 AM 0650 PM 1830 Stop Watch S/N _____ Bar. Press. AM 748 mm Hg PM 746 mm Hg

Flow Corr. Factor* AM 0.9630 PM 0.9553

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, sec/400 cc, 0" Hg				Flow Meter Rdg, l/m		Bubble Meter Flow		Avg. Flow from Pre- & Post Sampling Calibration, cc/min
				1	2	3	Avg	0" Hg	10" Hg	cc/min	scc/min**	
A121	174618	Yes	Yes	6.68	6.68	6.69	6.68	3.59	3.59	3593	3460	(-3.8%)
				6.90	6.88	6.89	6.89	3.49	3.49	3483	3327	3394
A143	174613	"	"	6.32	6.32	6.29	6.31	3.85	3.85	3803	3662	(-3.5%)
				6.49	6.51	6.48	6.49	3.61	3.61	3698	3533	3598
A062	174632	"	"	6.35	6.38	6.38	6.37	3.80	3.79	3768	3629	(-5.8%)
				6.71	6.73	6.64	6.71	3.57	3.57	3577	3417	3523
A037	174624	"	"	6.28	6.29	6.31	6.29	3.79	3.79	3816	3675	(-1.9%)
				6.37	6.36	6.35	6.36	3.77	3.74	3774	3605	3640
A032	174630	"	"	6.41	6.38	6.39	6.39	3.79	3.79	3756	3617	(-3.2%)
				6.54	6.56	6.54	6.55	3.50	3.50	3664	3500	3559
A083	174625	"	"	6.46	6.43	6.44	6.44	3.78	3.78	3727	3589	(-5.3%)
				6.76	6.76	6.74	6.75	3.50	3.50	3556	3397	3493
A061	174628	"	"	6.27	6.28	6.27	6.27	3.79	3.79	3828	3686	(-3.4%)
				6.42	6.44	6.46	6.44	3.53	3.52	3727	3560	3623
A126	174616	"	"	6.29	6.29	6.27	6.28	3.78	3.78	3822	3681	(-2.2%)
				6.36	6.36	6.38	6.37	3.55	3.53	3768	3600	3641
A087	174615	"	"	6.40	6.39	6.40	6.40	3.80	3.79	3750	3611	(-3.8%)
				6.60	6.60	6.59	6.60	3.58	3.55	3636	3473	3542
5138	176801	"	"	6.22	6.19	6.20	6.20	3.81	3.81	3871	3728	(-4.1%)
				6.40	6.42	6.40	6.41	3.55	3.53	3744	3577	3653
5116	176819	"	"	6.27	6.30	6.26	6.28	3.79	3.71	3822	3681	(-3.9%)
				6.48	6.49	6.48	6.48	3.62	3.62	3704	3538	3610

*Correction to 25 C, 760 mm Hg (see tables).

**scc/min = cc/min x correction factor.

Data Check by/Date Todd M. Lemmon 8/10/84

Form DSPC-012183

Battelle
Columbus Laboratories

DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon/Sgontz Jr. Calibrator S/N _____ Amb. Temp. AM 23°C PM 24°C
Date/Time 7/24/84 AM 0650 PM 1830 Stop Watch S/N _____ Bar. Press. AM 748 mm Hg PM 746 mm Hg
Flow Corr. Factor* AM 0.9630 PM 0.9553

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, sec/400 cc, 0" Hg 1	2	3	Avg	Flow Meter Rdg, ℓ/m 0" Hg	10" Hg	Bubble Meter Flow cc/min	sec/min**	Avg. Flow from Pre- & Post Sampling Calibration, sec/min
5136	176798	Yes	Yes	6.43	6.44	6.45	6.44	3.78	3.78	3727	3589	(-5.3%)
				6.74	6.75	6.76	6.75	3.38	3.38	3556	3397	3493
A092	174620	"	"	6.41	6.41	6.39	6.40	3.79	3.79	3750	3611	(-4.5%)
				6.66	6.65	6.64	6.65	—	—	3609	3448	3530
9806	174626	"	"	6.31	6.31	6.30	6.31	3.78	3.78	3803	3662	(-1.3%)
				6.33	6.34	6.35	6.34	3.59	3.59	3785	3616	3639

*Correction to 25 C, 760 mm Hg (see tables).
**sec/min = cc/min x correction factor.

Data Check by/Date Todd M. Lemmon 8/10/84
Form DSPC-012183

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DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon/Sgontz Jr. Calibrator S/N _____ Amb. Temp. AM 23°C PM 24°C

Date/Time 7/25/84 AM 0630 PM 1800 Stop Watch S/N _____ Bar. Press. AM 747 mm Hg PM 747 mm Hg

Flow Corr. Factor* AM 0.9617 PM 0.9567

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, sec/400 cc, 0" Hg				Flow Meter Rdg, l/m		Bubble Meter Flow		Avg. Flow from Pre- & Post Sampling Calibration, cc/min
				1	2	3	Avg	0" Hg	10" Hg	cc/min	sec/min**	
A118	174611	Yes	Yes	6.26	6.26	6.28	6.27	3.81	3.81	3828	3681	(-0.8%)
				6.30	6.29	6.28	6.29	3.80	3.80	3816	3651	3666
A143	174613	"	"	6.30	6.30	6.30	6.30	3.75	3.75	3810	3664	(-2.4%)
				6.43	6.43	6.41	6.42	3.79	3.79	3738	3576	3620
5157	176787	"	"	6.23	6.24	6.24	6.24	3.80	3.80	3846	3699	(-1.9%)
				6.34	6.34	6.31	6.33	3.79	3.79	3791	3627	3663
A083	174625	"	"	6.25	6.26	6.27	6.26	3.80	3.80	3834	3687	(-1.6%)
				6.34	6.32	6.34	6.33	3.79	3.79	3791	3627	3657
A087	174615	"	"	6.25	6.22	6.25	6.24	3.80	3.80	3846	3699	(-1.5%)
				6.31	6.31	6.28	6.30	3.80	3.80	3810	3645	3672
A037	174624	"	"	6.09	6.09	6.11	6.10	3.78	3.77	3934	3783	(-1.6%)
				6.18	6.16	6.16	6.17	3.89	3.89	3890	3722	3753
A121	174618	"	"	6.25	6.26	6.28	6.26	3.76	3.73	3834	3687	(-1.0%)
				6.29	6.29	6.29	6.29	3.82	3.82	3816	3651	3669
A062	174632	"	"	6.21	6.22	6.22	6.22	3.77	3.73	3859	3711	(-2.0%)
				6.30	6.31	6.32	6.31	3.75	3.72	3803	3638	3675
A126	174616	"	"	6.08	6.09	6.06	6.08	3.80	3.79	3947	3796	(-1.0%)
				6.11	6.11	6.11	6.11	3.79	3.75	3928	3758	3777
A089	174633	"	"	6.07	6.09	6.11	6.09	3.80	3.79	3941	3790	(-0.8%)
				6.09	6.11	6.13	6.11	3.75	3.72	3928	3758	3774
5138	176801	"	"	6.09	6.06	6.08	6.08	3.80	3.80	3947	3796	(-1.2%)
				6.11	6.12	6.13	6.12	3.69	3.68	3922	3752	3774

*Correction to 25 C, 760 mm Hg (see tables).

**sec/min = cc/min x correction factor.

Data Check by/Date Todd H. Lemmon 8/10/84

Form DSPC-012183

Battelle
Columbus Laboratories

DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon/Sgontz Jr. Calibrator S/N _____ Amb. Temp. AM 23 °C PM 24 °C

Date/Time 7/25/84 AM 0930 PM 1000 Stop Watch S/N _____ Bar. Press. AM 747 mm Hg PM 747 mm Hg

Flow Corr. Factor* AM 0.9617 PM 0.9567

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, cc/400 cc, 0" Hg				Flow Meter Rdg, l/m		Bubble Meter Flow		Avg. Flow from Pre- & Post Sampling Calibration, cc/min
				1	2	3	Avg	0" Hg	10" Hg	cc/min	cc/min**	
A061	174628	Yes	Yes	6.10	6.09	6.12	6.10	3.79	3.79	3934	3783	(-2.9%)
				6.24	6.25	6.25	6.25	3.53	3.51	3840	3674	3729
A127	174622	"	"	6.11	6.09	6.08	6.09	3.79	3.78	3941	3790	(-1.3%)
				6.13	6.14	6.14	6.14	3.61	3.60	3909	3740	3765
4696	176817	"	"	6.02	6.04	6.04	6.03	3.80	3.79	3980	3828	(-2.3%)
				6.13	6.13	6.16	6.14	3.90	3.90	3909	3740	3784
A092	174620	"	"	6.05	6.05	6.07	6.06	3.81	3.80	3960	3808	(-0.5%)
				6.05	6.08	6.06	6.06	3.92	3.92	3960	3789	3799
9806	174626	"	"	6.03	6.03	6.04	6.03	3.79	3.79	3980	3828	(-1.5%)
				6.07	6.09	6.10	6.09	3.63	3.62	3941	3770	3799

*Correction to 25 C, 760 mm Hg (see tables).

**cc/min = cc/min x correction factor.

Data Check by/Date Todd H. Lemmon 8/10/84

Form DSPC-012183

Battelle
Columbus Laboratories

DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon / Sgontz, Jr. Calibrator S/N _____ Amb. Temp. AM 21 °C PM 21 °C

Date/Time 7/27/84 AM 0630 PM 1800 Stop Watch S/N _____ Bar. Press. AM 745 mm Hg PM 745 mm Hg

Flow Corr. Factor* AM 0.9688 PM 0.9688

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, sec/400 cc, 0" Hg				Flow Meter Rdg, ℓ/m		Bubble Meter Flow		Avg. Flow from Pre- & Post Sampling Calibration, cc/min
				1	2	3	Avg	0" Hg	10" Hg	cc/min	cc/min**	
A089	174633	Yes	Yes	6.29	6.26	6.28	6.28	3.82	3.82	3822	3703	(-1.3%)
				6.36	6.36	6.35	6.36	3.71	3.71	3774	3656	3680
A126	174616	"	"	6.30	6.34	6.34	6.33	3.79	3.79	3791	3673	(-1.9%)
				6.46	6.43	6.47	6.45	3.68	3.68	3721	3605	3639
5116	176819	"	"	6.26	6.26	6.27	6.26	3.80	3.80	3834	3714	(-3.3%)
				6.45	6.49	6.47	6.47	3.70	3.68	3709	3593	3654
A120	174612	"	"	6.33	6.32	6.31	6.32	3.79	3.79	3797	3679	(-2.3%)
				6.47	6.47	6.47	6.47	3.69	3.69	3709	3593	3636
A092	174620	"	"	6.32	6.31	6.34	6.32	3.80	3.80	3797	3679	(-2.0%)
				6.46	6.44	6.44	6.45	3.70	3.70	3721	3605	3642
5138	176801	"	"	6.22	6.23	6.21	6.22	3.81	3.80	3859	3739	(-2.7%)
				6.39	6.40	6.38	6.39	3.75	3.72	3756	3639	3689
9806	174626	"	"	6.22	6.21	6.22	6.22	3.82	3.82	3859	3739	(-1.5%)
				6.33	6.31	6.29	6.31	3.72	3.72	3803	3684	3712
A143	174613	"	"	6.36	6.37	6.35	6.36	3.79	3.79	3774	3656	(-1.1%)
				6.43	6.43	6.44	6.43	3.99	3.99	3733	3617	3637
A061	174628	"	"	6.24	6.23	6.23	6.23	3.81	3.80	3852	3732	(-3.1%)
				6.42	6.43	6.44	6.43	3.73	3.72	3733	3617	3675
A079	174621	"	"	6.24	6.25	6.26	6.25	3.80	3.79	3840	3720	(-1.4%)
				6.34	6.34	6.34	6.34	3.79	3.78	3785	3667	3694
A087	174615	"	"	6.30	6.30	6.32	6.31	3.78	3.76	3803	3684	(-0.8%)
				6.35	6.35	6.37	6.36	3.80	3.79	3774	3656	3670

*Correction to 25 C, 760 mm Hg (see tables).

**sec/min = cc/min x correction factor.

Data Check by/Date Todd H. Lemmon 8/10/84

Form DSPC-012183

Battelle
Columbus Laboratories

DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon / Saenz Jr. Calibrator S/N _____ Amb. Temp. AM 21°C PM 21°C

Date/Time 7/27/84 AM 0638 PM 1800 Stop Watch S/N _____ Bar. Press. AM 745 mm Hg PM 745 mm Hg

Flow Corr. Factor* AM 0.9688 PM 0.9688

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, sec/400 cc, 0" Hg				Flow Meter Rdg, l/m		Bubble Meter Flow		Avg. Flow from Pre- & Post Sampling Calibration, sec/min
				1	2	3	Avg	0" Hg	10" Hg	cc/min	sec/min**	
5157	176787	Yes	Yes	6.25	6.26	6.27	6.26	3.79	3.79	3834	3714	(-1.7%)
				6.36	6.37	6.37	6.37	3.79	3.78	3768	3650	3682
A127	174622	"	"	6.22	6.23	6.25	6.23	3.79	3.79	3852	3732	(-0.6%)
				6.26	6.28	6.28	6.27	3.83	3.82	3828	3709	3721
A037	174624	"	"	6.26	6.28	6.29	6.28	3.77	3.75	3822	3703	(-1.9%)
				6.40	6.40	6.40	6.40	3.78	3.76	3750	3633	3668
A118	174611	"	"	6.22	6.23	6.25	6.23	3.80	3.80	3852	3732	(-1.1%)
				6.28	6.30	6.32	6.30	3.82	3.81	3810	3691	3712
A062	174632	"	"	6.26	6.26	6.28	6.27	3.81	3.81	3828	3709	(-0.7%)
				6.29	6.31	6.33	6.31	3.80	3.80	3803	3684	3697

*Correction to 25 C, 760 mm Hg (see tables).

**sec/min = cc/min x correction factor.

Data Check by/Date Todd H. Lemmon 8/13/84

Form DSPC-012183

Battelle
Columbus Laboratories

DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon/Sgontz Jr. Calibrator S/N _____ Amb. Temp. AM 21°C PM 21°C
Date/Time 7/28/84 AM 0645 PM 1800 Stop Watch S/N _____ Bar. Press. AM 748 mm Hg PM 747 mm Hg
Flow Corr. Factor* AM 0.9727 PM 0.9714

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data: Bubble Meter, cc/400 cc, 0" Hg				Flow Meter Rdg, l/m		Bubble Meter Flow		Avg. Flow from Pre- & Post Sampling Calibration, cc/min
				1	2	3	Avg	0" Hg	10" Hg	cc/min	cc/min**	
A121	174618	Yes	Yes	6.09	6.09	6.08	6.09	3.95	3.90	3941	3833	(-2.2%)
				6.24	6.22	6.21	6.22	3.82	3.82	3859	3749	3791
A089	174633	"	"	6.19	6.17	6.18	6.18	3.88	3.88	3883	3777	(+1.4%)
				6.10	6.08	6.10	6.09	3.99	3.99	3941	3828	3803
A126	174616	"	"	6.39	6.38	6.37	6.38	3.70	3.70	3762	3659	(0.0%)
				6.38	6.38	6.35	6.37	3.75	3.75	3768	3660	3660
A143	174613	"	"	6.37	6.35	6.36	6.36	3.70	3.70	3774	3671	(-0.5%)
				6.37	6.39	6.38	6.38	3.80	3.80	3762	3654	3663
5157	176787	"	"	6.29	6.29	6.29	6.29	3.71	3.71	3816	3712	(-4.1%)
				6.53	6.55	6.56	6.55	3.72	3.72	3664	3559	3636
A061	174628	"	"	6.20	6.21	6.22	6.21	3.87	3.85	3865	3759	(-1.2%)
				6.27	6.28	6.29	6.28	3.73	3.70	3822	3713	3736
A062	174632	"	"	6.38	6.39	6.40	6.39	3.79	3.78	3756	3653	(-0.4%)
				6.40	6.42	6.42	6.41	3.52	3.51	3744	3637	3645
A079	174621	"	"	6.36	6.38	6.39	6.38	3.80	3.79	3762	3659	(-0.4%)
				6.38	6.40	6.42	6.40	3.55	3.54	3750	3643	3651
A118	174611	"	"	6.34	6.35	6.36	6.35	3.80	3.80	3780	3677	(+0.7%)
				6.28	6.30	6.32	6.30	3.63	3.61	3810	3701	3689
A120	174612	"	"	6.36	6.39	6.39	6.38	3.80	3.80	3762	3659	(-0.6%)
				6.39	6.41	6.43	6.41	3.56	3.54	3744	3637	3648
A092	174620	"	"	6.31	6.33	6.33	6.32	3.81	3.80	3797	3693	(+0.2%)
				6.29	6.30	6.32	6.30	3.80	3.79	3810	3701	3697

*Correction to 25 C, 760 mm Hg (see tables).
**scc/min = cc/min x correction factor.

Data Check by/Date Todd E. Lemmon 8/13/84
Form DSPC-012183

Battelle
Columbus Laboratories

DUPONT SAMPLING PUMP FLOW CALIBRATION

Performed by Lemmon / Saentz, Jr. Calibrator S/N _____ Amb. Temp. AM 21 °C PM 21 °C

Date/Time 7/28/84 AM 0645 PM 1900 Stop Watch S/N _____ Bar. Press. AM 748 mm Hg PM 747 mm Hg

Flow Corr. Factor* AM 0.9727 PM 0.9714

Pump S/N	EPA No.	Battery ok? (Yes/No)	Low Flow Check ok? (Yes/No)	Calibration Data								Avg. Flow from Pre- & Post Sampling Calibration, cc/min
				Bubble Meter, sec/400 cc, 0" Hg				Flow Meter Rdg, l/m		Bubble Meter Flow		
				1	2	3	Avg	0" Hg	10" Hg	cc/min	sec/min**	
5138	176801	Yes	Yes	6.38	6.39	6.39	6.39	3.80	3.79	3756	3653	(+0.4%)
				6.35	6.36	6.38	6.36	3.77	3.77	3774	3666	3660
9806	174626	"	"	6.31	6.31	6.31	6.31	3.81	3.80	3803	3699	(+1.2%)
				6.22	6.23	6.23	6.23	3.85	3.82	3852	3742	3721
A037	174624	"	"	6.38	6.39	6.39	6.39	3.78	3.76	3756	3653	(-0.1%)
				6.38	6.39	6.39	6.39	3.53	3.51	3756	3649	3651

*Correction to 25 C, 760 mm Hg (see tables).

**sec/min = cc/min x correction factor.

Data Check by/Date Todd H. Lemmon 8/13/84

Form DSPC-012183

60

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HIGH VOLUME PCB SAMPLER FLOW CALIBRATION

Performed by Lemmon/Sgontz, Jr. Calibration Venturi S/N _____ Ambient Temperature _____ °C

Date/Time 7/24/84 0830 Manometer S/N _____ Bar. Press. _____ mm Hg

Sampler S/N	Variac Setting, V	Timer OK? Yes/No	Calibration Venturi Data: Manometer, in. H_2O	Calibration Venturi Data: Flow Rate, scfm(a)	Sampler Venturi Data: Magnehelic, in. H_2O	Sampler Venturi Data: Flow Rate, scfm(b)	% Difference, Cal. & Spl'r. Venturi Flow Rates	Comments
0002		Yes	5.4	8	41	*		
HEW2		"	5.4	8	42	*		
EPA-91		"	5.4	8	41	*		
EPA-94		"	5.4	8	42	*		
EPA-95		"	5.4	8	41	*		
6302		"	5.4	8	46	*		
EPA-11		"	5.4	8	43	*		
EPA-13		"	5.4	8	42	*		
EPA-92		"	5.4	8	41	*		
EPA-90		"	5.4	8	40	*		

(a) From Calibration Tables for Calibration Venturi Tube.
(b) From Calibration Tables for Venturi Tube in each Hi-Vol unit.

Data check by Todd Fr. Lemmon Date 8/9/84

* assumed to be ~8 scfm

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HIGH VOLUME PCB SAMPLER FLOW CALIBRATION

Performed by Lemmon/Spontz, Jr Calibration Venturi S/N _____ Ambient Temperature _____ °C

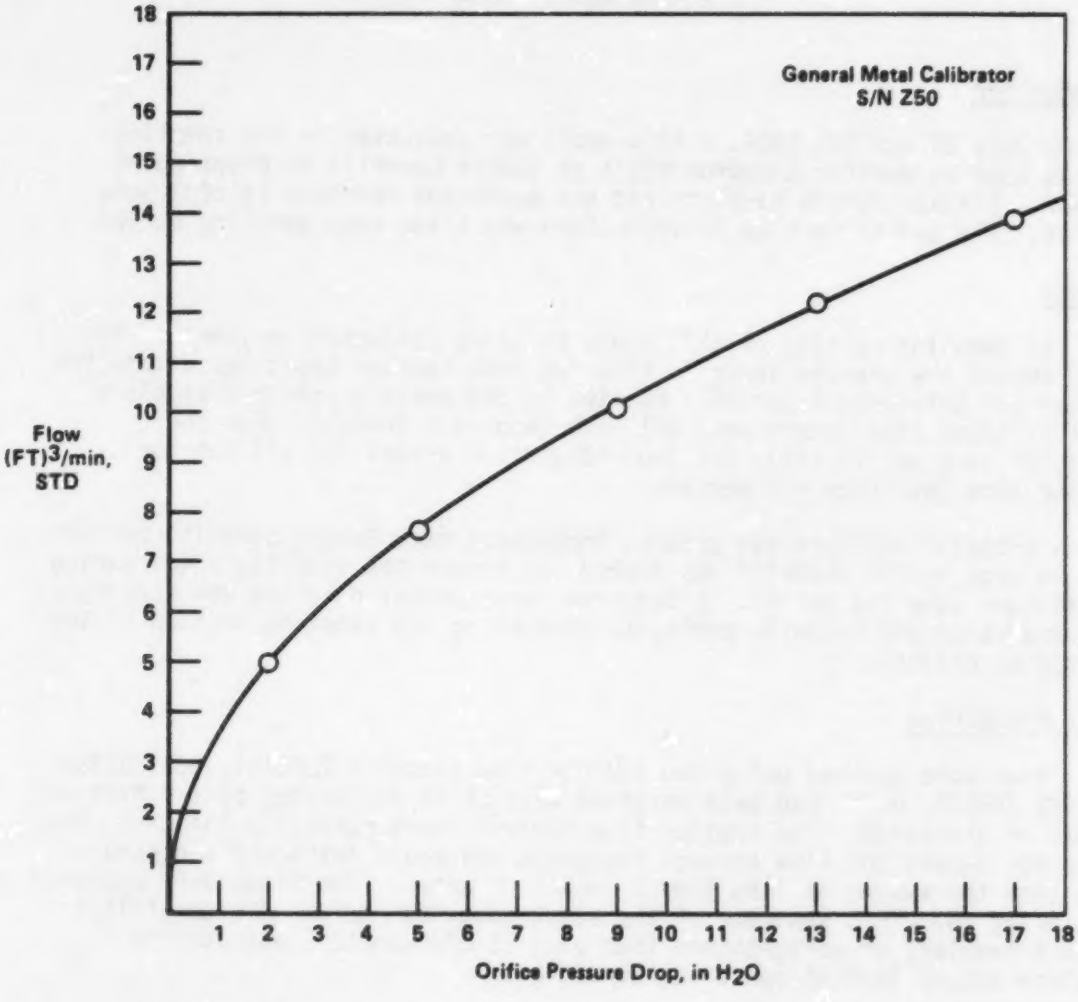
Date/Time 7/29/84 0830 Manometer S/N _____ Bar. Press. _____ mm Hg

Sampler S/N	Varlac Setting, V	Timer OK? Yes/No	Calibration Venturi Data		Sampler Venturi Data		% Difference, Cal. & Sple. Venturi Flow Rates	Comments
			Manometer, in. H_2O	Flow Rate, $\sqrt{\frac{\text{in. } H_2O}{\text{SCFM}}}$ (a)	Magnahelic, in. H_2O	Flow Rate, $\sqrt{\frac{\text{in. } H_2O}{\text{SCFM}}}$ (b)		
0002		Yes	5.4	8	41	*		
HEW2		"	5.4	8	42	*		
EPA-91		"	5.4	8	41	*		
EPA-94		"	5.4	8	42	*		
EPA-95		"	5.4	8	41	*		
6302		"	5.4	8	46	*		
EPA-11		"	5.4	8	43	*		
EPA-13		"	5.4	8	42	*		
EPA-92		"	5.4	8	41	*		
EPA-90		"	5.4	8	40	*		

(a) From Calibration Tables for Calibration Venturi Tube.
(b) From Calibration Tables for Venturi Tube in each Hi-Vol unit.

Data check by Todd F. Lemmon Date 8/15/84

* assumed to be ~8 scfm



Flow Vs Pressure Drop for Hi Vol Calibrator

APPENDIX E

EPA FLOW AUDIT REPORT

Introduction

On July 24 and 25, 1984, a flow audit was conducted on the sampling devices used to monitor airborne PCB's at Neal's Landfill in Bloomington, Indiana. Sixteen DuPont samplers and six pesticide samplers (8 cfm) were audited. The audits were conducted before and after each sampling period.

Summary

The sampling portion of this study is being conducted very well. The audit showed the average error in flow for both sampler types was within the ±10 percent tolerance interval. For the DuPont battery operated samplers, the individual flow errors were all less than -4.0 percent. For the pesticide samplers (8 cfm), the individual flow errors for all but one sampler were less than ±10 percent.

A Battelle employee was present throughout each 8-hour sampling period and the gate to the landfill was locked (to secure the sampling area) during the 24-hour sampling period. I observed very careful handling and sealing of the samples by the Battelle employees conducting the sampling portion of the monitoring project.

Audit Procedures

Flows were audited using two laminar flow elements (LFE's), S/N 702254 and S/N 705638, which had been verified with LFE's calibrated by the National Bureau of Standards. The laminar flow elements were carefully chosen so they would not impede the flow through the pumps and would introduce a pressure drop into the system of less than 2 inches of water. The flows were measured by placing the LFE's upstream of the blank sampling media. A clean filter (DuPont sampler) or polyurethane foam plug (8 cfm sampler) was used to simulate actual initial operating conditions.

Since the DuPont portable sampling pumps were being calibrated in the motel room, the pumps used at both sites were audited immediately after Battelle's pre-sampling flow calibration and in the evening at the end of the 8-hour sampling period. Twenty pumps were audited in the morning and sixteen in the evening. Four were carried to the field as spares but not utilized.

Six pesticide samplers (8 cfm) were audited in the field prior to their respective sampling periods; five were audited at the end of their 24-hour sampling period. One sampler did not complete the sampling period because the portable generator failed.

Results

As shown in Table I, all the DuPont pumps are performing very well; the average difference was -2.6 percent and the maximum was only -3.7 percent. This negative figure does indicate a small amount of systematic bias. Thus, the DuPont samplers showed individual as well as average percent differences below the 10 percent limit set by QAD as a maximum allowable error.

On the other hand, the average percent difference for the 8 cfm samplers was +7.2 percent (Table II). The 8 cfm samplers showed one individual difference exceeding the 10 percent QAD allowable error. The errors exhibited on the 8 cfm may require further explanation and investigation, but I believe part of the error can be attributed to the difficulty in obtaining accurate readings from a magnehelic.

TABLE I. FLOW AUDIT - BLOOMINGTON, INDIANA

	Pump Serial Number	Initial Calibration Flow, cc/min	Final Calibration Flow, cc/min	Audit Flow cc/min	Difference cc/min	Difference Percent	
	A-087	3699		3800	101	-2.7	
	A-087		3645	3763	118	-3.1	
	A-037	3783		3880	87	-2.2	
	A-037		3722	3840	118	3.1	
	A-127	3790		3861	71	-1.8	
	A-127		3740	3860	120	-3.1	
	4696	3828		3891	63	-1.6	
	4696		3740	3880	140	-3.6	
	5157	3699		3792	93	-2.5	
	5157		3627	3752	125	-3.3	

All Flows at STP

TABLE I. (Continued)

Pump Serial Number	Initial Calibration Flow, cc/min	Final Calibration Flow, cc/min	Audit Flow cc/min	Difference cc/min	Difference Percent
A-092	3808		3892	84	-2.2
A-092		3789	3880	91	-2.3
A-083	3687		3811	124	-3.3
A-083		3627	3704	77	-2.1
9806	3828		3891	63	-1.6
9806		3770	3889		-3.1
A-089	3790		3893	103	-2.6
A-089		3758	3881	123	-3.2
A-118	3681		3803	122	-3.2
A-118		3651	3772	121	-3.2

All Flows at STP

TABLE I. (Continued)

Pump Serial Number	Initial Calibration Flow, cc/min	Final Calibration Flow, cc/min	Audit Flow cc/min	Difference cc/min	Difference Percent
5138	3796		3893	97	-2.5
5138		3752	3890	138	-3.5
A-061	3783		3883	100	-2.6
A-061		3674	3790	116	-3.1
A-143	3664		3743	79	-2.1
A-143		3576	3713	137	-3.7
A-121	3687		3803	116	-3.1
A-121		3651	3763	112	-3.0
A-062	3711		3823	112	-2.9
A-062		3638	3772	134	-3.6

All Flows at STP

TABLE I. (Continued)

	Pump Serial Number	Initial Calibration Flow, cc/min	Final Calibration Flow, cc/min	Audit Flow cc/min	Difference cc/min	Percent	
	A-126	3796		3903	107	-2.7	
	A-126		3758	3861	103	-2.7	
				Average		-2.60	

All Flows at STP

TABLE II. FLOW AUDIT - BLOOMINGTON, INDIANA

	Pump Serial Number	Initial Calibration Flow, cc/min	Final Calibration Flow, cc/min	Audit Flow cc/min	Difference cc/min	Difference Percent	
	EPA-0002	226,528		210,982	15,546	7.4	
	EPA-0002		226,528	213,353	13,175	6.2	
	EPA-91	226,528		207,194	19,334	9.3	
	EPA-91		226,528	213,499	13,029	6.5	
	EPA-94	226,528		212,723	13,805	6.5	
	EPA-94		226,528	219,361	7,167	3.3	
	EPA-95	226,528		203,792	22,736	11.25	
	EPA-95		226,528	208,026	18,502	8.9	

All Flows at STP

TABLE II. (Continued)

	Pump Serial Number	Initial Calibration Flow, cc/min	Final Calibration Flow, cc/min	Audit Flow cc/min	Difference cc/min	Percent	
	6302	226,528		210,712	15,816	7.5	
	6302		226,528	214,456	12,072	5.6	
				Average		7.2	

All Flows at STP

APPENDIX F

METEOROLOGICAL DATA

The meteorological data obtained during the field study are presented in this appendix. The wind speed, wind direction, and ambient temperature measurements were performed with Meteorological Research, Inc. (MRI) portable weather stations located at both Neal's Landfill and Neal's Dump. Periodic relative humidity measurements were performed with a psychometer.

METEOROLOGICAL DATA(a)

Date: 7/24/84 Site: Neal's Landfill

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100			32	48
1100-1200			32	48
1200-1300			32	48
1300-1400			32	52
1400-1500			32	52
1500-1600			30	61
1600-1700			30	62
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA(a)

Date: 7/27/84 Site: Neal's Landfill

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				76
0900-1000				71
1000-1100				59
1100-1200	0.5	210	22	
1200-1300	0.6	180	24	
1300-1400	0.7	210	24	54
1400-1500	0.4	180	24	56
1500-1600	0.3	200	25	52
1600-1700	0.1	185	25	
1700-1800	0.1	170	25	
1800-1900	0.0	220	24	
1900-2000	0.0	220	22	
2000-2100	0.0	290	18	
2100-2200	0.0	280	16	
2200-2300	0.0	200	14	
2300-2400	0.0	210	13	

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA[a]

Date: 7/28/84 Site: Neal's Landfill

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100	0.0	240	14	
0100-0200	0.0	250	15	
0200-0300	0.0	210	15	
0300-0400	0.0	210	16	
0400-0500	0.0	10	15	
0500-0600	0.0	300	15	
0600-0700	0.0	330	16	
0700-0800	0.0	120	16	
0800-0900	0.0	140	18	
0900-1000	0.0	230	22	76
1000-1100	0.0	190	23	71
1100-1200	0.1	230	26	
1200-1300	0.4	280	26	
1300-1400	0.4	260	23	
1400-1500	0.0	80	20	
1500-1600	0.3	300	21	
1600-1700	0.1	230	17	
1700-1800	0.0	250	17	
1800-1900	0.0	230	19	
1900-2000	0.0	280	19	
2000-2100	0.0	210	19	
2100-2200	0.0	330	17	
2200-2300	0.0	10	15	
2300-2400	0.0	20	15	

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA(a)

Date: 7/29/84 Site: Neal's Landfill

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100	0.0	20	13	
0100-0200	0.0	60	13	
0200-0300	0.0	65	13	
0300-0400	0.0	100	13	
0400-0500	0.0	190	12	
0500-0600	0.0	195	12	
0600-0700	0.0	190	11	
0700-0800	0.0	175	11	
0800-0900	0.0	145	12	
0900-1000	0.0	175	15	
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA[a]

Date: 7/25/84 Site: Neal's Dump

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100	1.3	35	26	75
1100-1200	1.0	40	25	84
1200-1300	0.8	40	23	92
1300-1400	1.1	90	25	
1400-1500	1.3	85	28	
1500-1600	1.3	85	28	80
1600-1700	1.3	95	28	76
1700-1800	1.0	70	28	68
1800-1900	0.5	75	27	
1900-2000	0.6	85	26	
2000-2100	0.3	45	23	
2100-2200	0.4	85	22	
2200-2300	0.4	95	21	
2300-2400	0.3	15	20	

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA(a)

Date: 7/26/84 Site: Neal's Dump

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100	0.3	5	19	
0100-0200	0.4	210	19	
0200-0300	0.3	40	19	
0300-0400	0.2	30	18	
0400-0500	0.3	220	18	
0500-0600	0.3	0	18	
0600-0700	0.7	310	19	
0700-0800	0.7	120	19	
0800-0900	0.6	220	20	
0900-1000	0.8	100	22	
1000-1100	1.4	115	25	
1100-1200	1.0	120	28	
1200-1300	1.3	170	30	
1300-1400	2.9	220	26	
1400-1500	1.3	245	20	
1500-1600	1.0	220	21	
1600-1700	1.4	270	23	
1700-1800	1.2	280	24	
1800-1900	1.7	275	23	
1900-2000	2.1	280	22	
2000-2100	1.3	300	19	
2100-2200	1.0	290	17	
2200-2300	1.1	305	17	
2300-2400	1.2	335	17	

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA[a]

Date: 7/27/84 Site: Neal's Dump

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100	1.1	350	17	
0100-0200	0.9	350	17	
0200-0300	0.6	290	17	
0300-0400	0.6	310	17	
0400-0500	0.5	320	17	
0500-0600	0.5	290	17	
0600-0700	0.7	280	16	
0700-0800	0.9	20	17	
0800-0900	1.1	30	18	
0900-1000	1.3	20	20	
1000-1100	1.3	320	21	
1100-1200	1.3	0	23	
1200-1300	1.3	20	25	
1300-1400	1.3	30	26	
1400-1500	1.2	10	27	
1500-1600	1.1	30	27	
1600-1700	1.3	340	26	
1700-1800	1.1	20	26	
1800-1900	0.6	50	25	
1900-2000	0.4	20	23	
2000-2100	0.3	40	20	
2100-2200	0.2	65	17	
2200-2300	0.1	70	16	
2300-2400	0.2	60	16	

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.

METEOROLOGICAL DATA[a]

Date: 7/28/84 Site: Neal's Dump

Time Period Hrs, CDT	Avg. Wind Speed, m/s	Avg. Wind Direction, °Compass	Ambient Temp., °C	Relative Humidity, %
0000-0100	0.4	120	15	
0100-0200	0.3	90	16	
0200-0300	0.2	120	16	
0300-0400	0.1	140	16	
0400-0500	0.4	100	16	
0500-0600	0.1	70	16	
0600-0700	0.1	80	16	
0700-0800	0.4	160	17	
0800-0900	0.6	300	20	76
0900-1000	0.9	320	22	
1000-1100	1.1	315	26	71
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				

(a) Data obtained with MRI portable weather station at 2.5 meters above ground level.